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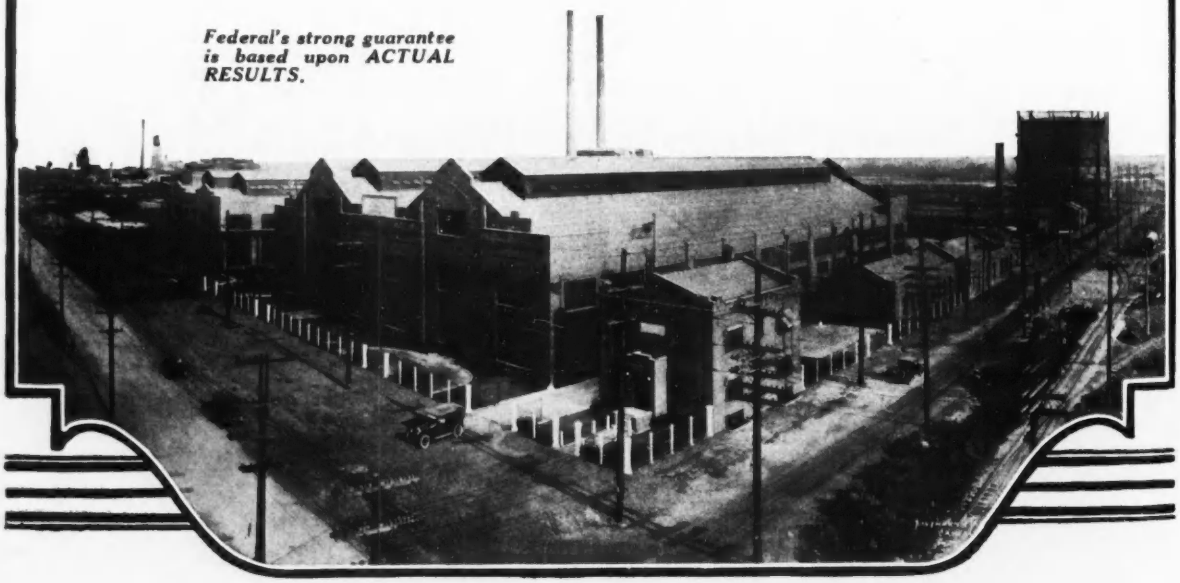

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AND CONTRACTING

E. J. Mehren
Editor

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The Results of the Questionnaire

QUESTION 3, on which discussion centered during the balloting on the questionnaire of the American Society of Civil Engineers, has been lost. That is the outstanding fact in connection with the returns.

Questions 1 and 2, on external relations, which provide for civic and welfare activity, were, on the other hand, carried, indicating that the society disapproved only of the special means for such activity recommended by the development committee, that is, through federation with other national and with local societies.

The questions relating to internal changes were carried, with the exception of Number 7, which provided for an increase in non-resident dues of more than $5, but not more than $10 per annum. Question 6, which provides for an increase in non-resident dues of not more than $5, on the other hand, carried.

Fortunately the results are clear. The society does favor a broader program; it does favor co-operation with other societies; it objects only to the particular method of co-operation proposed by the Joint Conference Committee. The society favors increased internal activities and a democratization of its organization—and is willing to have its non-residents pay $5 additional to meet the cost.

Therefore, there is clear gain. We know definitely that a broader scope is desired, and that the members approve of co-operative effort. We know that they want greater internal activity and are willing to pay for it.

One of the very notable features of the result is that the largest majority on any proposal was polled on Question B3 (of the internal group), that which provides that the directors in each geographical district be nominated and elected by vote of the corporate members resident therein. Out of a total of 3,743 votes cast on this question there were only 567 adverse votes. Moreover, it is interesting to note that District 1, generally considered as favorable to the present method of organization, cast 568 *for* and only 176 *against* the more democratic method propqsed by Question B3.

In defeating Question 3, under external relations, the safer, the more conservative, course has been pursued. The society avoids work that would have been onerous, indeed. There surely was opportunity for unfavorable alliances, as the opponents predicted. We know that many members were adverse to federation, but we did not feel that there was serious danger.

One may properly ask how the two votes, one favoring co-operative effort and the other opposed to the Joint Conference plan, are to be interpreted. We understand them to mean that the society favors co-operation only when it is in a position to exercise a very powerful, if not a dominating, influence. That, too, is a safe and conservative course, surely calculated to preserve the society's prestige.

Now that the decision has been made, *Engineering News-Record* is not going to quarrel with it. Question 3 was lost by a majority vote of 87, in a total vote, on that question, of 3,821. Districts 1 and 3, including the Metropolitan district, New York State and Canada, cast a total of 1,074 ballots, with 287 in favor of the proposal and 787 against it. The adverse vote was, thus, more than 3 to 1, and the adverse majority 500. On the other hand, all the other districts cast 2,747 ballots with a majority *favoring* the proposal of 413. In other words, New York City and New York State, for the Canadian vote is very small, overcame the favorable majority of the rest of the country and defeated the proposal by 87 votes. District 8, including Illinois, Indiana, Kentucky and Tennessee, was the only one besides Districts 1 and 3 to vote adversely on Question 3. Its negative majority in a total of 271 votes was 29.

The closeness of the vote and the fact that New York negatived the positive vote of the rest of the country may cause dissatisfaction, but with such dissatisfaction we would have no sympathy, particularly since all the other proposals were carried. Certainly every effort was made to get out the vote. Discussion was lengthy and many sided. The minds of the members were directed to the full merits of the question, yet in the whole country outside of New York the number of members who favored Question 3 exceeded those who opposed it by only 413. In other words, the whole country did not come down to New York with a landslide in favor of the Joint Conference proposal. Opinion was not evenly divided, it is true, but there was a favorable majority of only 413 in a total vote in those districts of 2,747.

Moreover, the adverse majority of 87 should be considered in the light of the fact that on all other questions the vote was favorable by ratios ranging from 2 to 1 to nearly 6 to 1. In other words, such was the feeling against Question 3 that despite overwhelming positive majorities on all other proposals, that question was defeated.

As to conclusions from the ballot, certainly the vote precludes the entrance of the American Society of Civil Engineers into the conference planned by the Joint Conference Committee, and will be a serious blow to the federation movement—if it does not kill it entirely. There have been repeated assurances that the other societies would go ahead alone, and we, ourselves, have said they should do so. Possibly, though, the withdrawal of the civils may prompt the almost total abstinence of the locals. Under that condition the movement would be dead.

It is evident, too, that the defeat of Question 3 is likely to give a strong impetus to the American Association of Engineers. If the men who, while opposing

Question 3, approved of the A. A. E., will act in accordance with their expressed views, that organization will have an accretion of a goodly number of strong men. If they add to the association's balance and prestige without slowing up its work materially, the A. A. E. will set an example that even the strongest and most virile federation would have difficulty in equalling.

For ourselves, we have believed that federation—under the leadership of the founder societies—would be the quickest way of bringing about unified professional action. The majority does not so believe, and, therefore, as civil engineers we must address ourselves to studying other means of functioning in civil and welfare matters. It is hardly likely that there will be other than very limited activity through the society itself. We take the adverse vote as equivalent to bidding us to function through another body.

The smoke of battle will now clear away. The differences should be forgotten, and energies concentrated on the great work of strengthening the internal activities and reforming the organization as provided in the favorable vote on the second group of questions.

The heavy majorities on that group, supported by a willingness to provide larger funds, are an indication of the enthusiasm with which the membership will approach the task of expanding the activities and changing the form of organization. That for which so many members have argued and waited—increased activity—is in a way to become an accomplished fact.

To those who, like ourselves, hoped that Question 3 would carry there is this consolation—that the society has elected to proceed on the surer, the safer course. After all, the greatest asset the society has is its prestige, and that surely is preserved by the results of the ballot. We do not believe it would have been injured by participation in the proposed federation.

The work that was to have been done by the federation must be done. That is universally conceded. We are content, if the profession wills it so, to turn to another agency. What we are concerned about is merely that the work shall be done, and that it shall be done well and creditably to the profession.

Break-Up of the Railroad Strike

A WEEK ago the outlaw railroad strike had reached such proportions that it promised to become a national calamity. At this writing, the strike appears to have practically broken up. Now that the Railroad Labor Board has been organized the matter of wages may be duly presented. Had not the law provided such recourse, the case of the employees, which we believe is a good one in itself, would probably have been lost—through force of public sentiment and the attitude of the railroad managements as a result of the ill-advised attempts to tie-up the roads without warning. It was pointed out in an article by Charles Whiting Baker, in *Engineering News-Record* of Feb. 19, 1920, p. 385, that the railroad wage increases already granted had been more than offset by the rising cost of living. When the railroad unions presented their demands some eight or nine months ago they were asked by officers of the Government to hold the matter in abeyance in the hope that the cost of living would be reduced. In the meantime it increased, and no action was taken. The stage was set for the radical strike organizer and for the time being his deception—that the brotherhoods secretly favored the strike—was successful. A good case has been injured by employing syndicalist methods in the false hope of their gaining a just end.

Renouncing the Plumb Plan

AN INTERESTING outcome of the railroad strike is the report that the Brotherhood of Railway Trainmen has withdrawn from the Plumb Plan League, mentioning the possibility that other of the brotherhoods may follow. It is pointed out that labor leaders fear the effect of the league's propaganda in fomenting outlaw strikes. This is indeed significant. When the Plumb plan was first proposed it appeared evident that it was really more a step toward a distinct end than an actual plan of railroad operation—the end being the control of the railroads by labor. Some of the propaganda of the Plumb Plan League appears to have planted seeds of sovietism, in fear of which the more far-seeing labor leaders are withdrawing their support.

Concrete Roadbed for Railways

MANY railway engineers will read with surprise the article on the use of concrete roadbed for railway track, published elsewhere in this issue, since it is not generally known that such construction has been in use for some years and with highly satisfactory results under conditions of heavy traffic and unstable soil. While the idea is not new, the feature of surprise will be that the existing installations are not experimental but form part of track construction where special methods are required to meet special conditions. Its main purpose is to reduce maintenance work and expense, in which it appears to have been quite successful.

On all roadbed, except in the rare cases of solid rock, there is a continual depression of track due to the ballast being worked into the soil of the roadbed. This must be made good by additional ballast to maintain the track at normal surface, which means a continual expenditure of money, material and labor. Where very soft ground occurs, such expenditures may be excessive and they result in no permanent improvement. With a concrete slab base to distribute the pressure and to separate the loose material of the ballast from the yielding soil, or to eliminate ballast entirely, this continual waste and work is avoided, with consequent saving in expense and more permanent maintenance of track.

That the present installations represent very diverse ideas on the part of their designers is only natural, in view of the limited extent of and experience with construction of this kind. Three points of distinct difference may be noted. In some cases ballast is eliminated, while in others the ordinary ballasted track is laid upon the concrete. Again, some have monolithic slabs over the entire length and width of the area to be covered, while others have rows of slabs of moderate length and built independently for each track. In the third place, it is of particular interest to note that while one engineer aims at an absolutely rigid track and roadbed, another adopts special means to ensure resilience or elasticity in the track.

Since maintenance of track is a large and troublesome factor in railway service, it appears reasonable to expect a further development of the concrete slab system, in view of the success obtained thus far at reasonable cost and under severe traffic conditions.

Street Congestion in the Cleveland Referendum

A QUESTION compounded of the elements of two important municipal engineering problems comes before the voters of Cleveland next week. One of the problems, at least, is quite new in its present-day aspect, as is also the composite. The citizens are to vote on a bond issue for constructing downtown terminal subways for street cars, a project intended to serve the dual purpose of relieving street congestion and later providing a rapid-transit trunk line.

Other cities are struggling with the problems of improving their street-traffic conditions and shortening the time of transit between living districts and business centers. In Detroit, a closely similar composite solution was worked out; it was rejected by the city recently, but under political circumstances that robbed the result of engineering significance. Pittsburgh and Cincinnati, with traffic conditions not greatly unlike those of Cleveland, are also considering both problems. A number of other communities have reason to concern themselves with either street congestion or rapid transit. Hence the broad meaning of the Cleveland vote.

Crowding of streets gave trouble many decades ago. Its new aspect of today is due to the many-storied office building, the great multiplication of automobiles, and increasing street-car concentration in downtown districts. The automobile has made the situation critical quite suddenly, the more so as street-car lines carrying heavy traffic tend to withdraw a good part of the street width from general use; and under the prevailing system of routing street-car lines with sole regard to their own traffic, and without consideration of other street services, downtown concentration of trolley routes is a natural result. Gradually increasing congestion in the business districts of large cities in recent years has made itself felt as a serious disadvantage to the commercial life of the communities. No advance has been made in dealing with the problem since the institution of police control of traffic, and definite proposals for a more thorough-going solution are quite recent. Since any effective solution is bound to involve large expenditures, little planning can be done until it is known whether the taxpaying public will be likely to vote the funds.

Last summer a clean-cut expression of the public attitude toward this question was obtained in Pittsburgh. A vote of $6,000,000 for a loop subway encircling the downtown district turned solely on the question of street congestion. The favorable outcome of the vote justified the deduction that the citizens of Pittsburgh see profit in an expenditure of $6,000,000 for improving downtown traffic by removing the street cars from the surface. The expected gain in commercial efficiency through greater ease and rapidity of communication in the business district is held to outweigh the cost of the enterprise. Thus the Pittsburgh vote furnished a helpful indication to engineers concerned with municipal services of all kinds.

The Cleveland referendum cannot have the same meaning, due to the fact that rapid transit is involved. In fact, rapid transit may be the dominant consideration in shaping the vote. This is unfortunate, for after the Pittsburgh decision in favor of eliminating street congestion it would be valuable to get confirmatory evidence on the attitude of the public.

An interesting statement of the way in which rapid transit is involved in the Cleveland project has been prepared for *Engineering News-Record* by the originator of the terminal subway project; it is published in the present issue. In the light of that statement the project presents itself as one for obtaining rapid transit by indirection. Reading the statement in conjunction with the original report on the project (see *Engineering News-Record*, July 24, 1919, p. 170), we may learn that a rapid-transit system in Cleveland at the present time would be unprofitable, and that its construction should therefore be postponed, but that piecemeal construction of a rapid-transit line can be made to pay its way by the device of utilizing parts of the system temporarily for the relief of street congestion. Thus, at the outset and during the early years, the $15,000,000 investment is to find its justification in the improvement of street-traffic conditions which it will bring about.

As to the permanent status of the street-congestion problem in Cleveland, the solution offered leaves obvious doubts. So far as the report and the statement commit themselves on this point, it appears to be considered that the initial improvement in street conditions will somehow be maintained when rapid-transit trains displace the surface cars in the subway. But this depends on whether or not the surface-car service will be permanently reduced; that is, whether most of the surface traffic will be transferred to the underground line. In view of city growth and the continuing need for short-haul car service, it would appear only prudent to assume that street congestion will be about the same after installation of the rapid-transit service as it is now. In other words, the present expenditure for relief of congestion might well be devoted to that purpose permanently.

Such considerations suggest that rapid transit and surface congestion are separate problems which do not accommodate themselves to a joint solution. In the same connection it needs to be recalled that many existing rapid-transit services have built up their own traffic, independent of and superimposed upon that of pre-existing lines, which means that rapid transit will increase rather than diminish congestion. This in turn means that the two problems in question are independent, or, if anything, antagonistic rather than co-operative, and therefore not amenable to co-operative solution. However, the enthusiastic support of the terminal-subway project by the city's able Rapid Transit Commission expresses a definite conclusion to the contrary effect.

Under the circumstances, the Cleveland referendum is no less interesting in its complexity than in the nature of the questions involved. While the vote will have great meaning for the city itself, it will not mean anything definite with regard to the traffic and transit problems of other cities. Were the dual purpose of the project fully clear to the voters, the result of the referendum would represent a popular verdict on the possibility and desirability of a joint solution. Or, again, were the vote simply on a project for eliminating street congestion, its result would constitute a most welcome confirmation of the Pittsburgh vote. But the present indications are that the issue will hinge on the public's desire for rapid-transit, and that little light will be thrown on the taxpayers' attitude toward expenditures for the relief of street congestion.

Henry Martyn Robert

Soldier, Parliamentarian, Author and Engineer—

An Appreciation of the Author of "Robert's Rules of Order," and Chief of Engineers, U. S. Army, Retired

TO every engineer no less than to every educated American citizen the title "Robert's Rules of Order" is a household word. We meet the little volume, or hear weekly references to it, upon our entrance into high-school debating societies. Later we take it into our college fraternities and clubs, and throughout busy professional and business lives we rest heavily upon it in all deliberative assemblies. We diligently thumb its pages to find authority to support our "points of order," and we unhesitatingly abide by the decision of the chair when he tells us that it conforms to Robert.

But how many engineers know that the author of that volume is one of their own professional brethren, that he is a civil engineer, a retired member of the Corps of Engineers of the United States Army and at one time Chief of Engineers?

Yet that is the case, and happily this young old man, now in his eighty-third year, is living a vigorous life at his home in Owego, N. Y., not resting upon his laurels but busily at work on another volume on parliamentary procedure.

Brigadier-General Henry Martyn Robert

Brigadier-General Henry M. Robert, U. S. A., retired, is of Southern ancestry, having been born at Robertville, S. C., May 2, 1837, the son of Rev. Joseph Thomas Robert, LL.D., and Adeline (Lawton) Robert. One of his ancestors, Pierre Robert, was pastor of the first Huguenot colony that landed in South Carolina after the revocation of the edict of Nantes. He entered the Military Academy at West Point in 1853 and was duly graduated in 1857. Then followed a busy life, for the country was young, requiring the services of army engineers in regions inaccessible by railroads. Moreover, the Civil War entered, with its feverish activity. While a cadet, at the age of nineteen, the future General on one occasion acted as assistant professor of mathematics, and immediately upon graduation was made acting assistant professor of natural philosophy and astronomy, and also acting assistant professor of practical military engineering. In 1858 he was ordered to Washington Territory with a detachment of troops to take command of engineering operations in a campaign against the Indians in Oregon and Washington. Lack of rail transportation made it necessary for him to go via Panama, and during his journey through the Tropics, though his scrupulous care protected his men from the then raging Panama fever, he himself took the disease—a matter that was only an incident then, but which interfered seriously with his activities during the Civil War.

While on service in Washington Territory he participated in a now almost forgotten incident that brought us near the verge of war with Great Britain. The dispute between Canada and the United States over the Northwest boundary had not been composed, and during the heat of the controversy, with Washington Territory cut off from Washington city except by long-delayed mail communication, all of the United States troops in the Northwest were ordered to San Juan Island in Puget Sound, and Lieutenant Robert was placed in charge of the construction of the defenses on the island. Eight 32 pounders, hardly more than saluting weapons, taken from the transport "Massachusetts," were the only artillery available, but these pieces were duly placed along the line of defense. Happily, no clash came, and on the arrival of General Winfield Scott the troops were withdrawn.

Ordered East just before the outbreak of the Civil War, he was, at the beginning of hostilities, placed in charge of the construction of a portion of the defenses of the City of Washington. He was, however, still suffering from the effects of the Panama fever and under the tremendous strain involved in preparing these defenses, his strength proved inadequate and he was transferred to Philadelphia, in connection with the work on the defenses of the city and its port. Again, however, his strength proved insufficient and in 1862 he was transferred to New Bedford, Mass., and placed in charge of the construction of defenses there. He continued at this point until the close of the war, and was then transferred to the Military Academy and placed in charge of the Department of Practical Military Engineering. Here he remained until 1867, when he was transferred to San Francisco as chief engineer of the Military Division of the Pacific. Subsequent transfers placed him in charge of defenses of the Columbia River, of the operations of the Thirteenth Lighthouse District, of harbor improvements in Oregon and Washington, of lighthouse construction on Lake Michigan, and, during an eight-year period, of harbor improvements on Lake Michigan, Green Bay, and Lake Superior.

Then his activities were transferred farther East, and from 1883 to 1885 various river and harbor work

on Lakes Erie, Ontario, and Champlain, and the St. Lawrence River occupied his attention. The Corps of Engineer activities in the neighborhood of Philadelphia were under his charge for five years. In 1890 he became engineer-commissioner of the District of Columbia and after a year of service was placed in charge of improvements on the Tennessee, Cumberland, and other rivers in that neighborhood, and later supervised river and harbor work on Long Island Sound and the fortifications of Long Island Sound and New York Harbor.

Served on Many Engineer Boards

He had by that time, 1895, been promoted to the rank of Colonel, and then began, backed by a long and varied experience, the most fruitful period of his engineering career. He was made division engineer of the Southwest Division, which included eleven engineer districts from Pittsburgh to Galveston, with headquarters at New York. In that capacity he continued until 1901, and during that period served as president of engineer boards on no less than thirty-three projects, including such notable improvements as the harbors at Galveston, Philadelphia, Pensacola, New York, and Bridgeport, river improvements that included the Delaware, the Hudson, and the East Rivers, and the Southwest Pass of the Mississippi. During this period and in the years immediately preceding he had served on eighteen other engineer boards, the reports including studies of improvements of the Columbia River and many harbors on the Great Lakes, among them Marquette, Green Bay, and Manitowoc. While stationed at New York he was president of the Board of Engineers for Fortifications, president of the New York Harbor Line Board, of the Philadelphia Harbor Line Board, and the Board for Examining Officers of the Corps of Engineers for promotion. One of the most important reports under his presidency was that on the new channel entrance to New York Harbor, which has since been constructed and now forms the main channel from sea to upper bay.

On April 30, 1901, he reached the headship of his Corps, as Chief of Engineers, with the rank of Brigadier General, but under the inexorable operation of the retirement law held the place for only three days.

His retirement, however, did not mark the close of his engineering endeavor. In fact, some of his most notable engineering work was done after that date.

While his name, necessarily, will be connected with works over a very large extent of territory, some of them of extremely great importance in the annals of river and harbor engineering, probably the port and city with which his name will be most connected is that of Galveston, Tex. Following the Galveston tidal wave disaster of 1900 he was appointed chairman of a board of engineers to report on methods of preventing destruction by future tidal waves, the other members of the board being Alfred Noble and Major H. C. Ripley. Their studies resulted in the recommendation of a seawall, which, under a somewhat modified design, was built and has effectively saved the city on two subsequent occasions. After the storm of 1909 General Robert was called in again, this time alone, to report on the repair of the damage done, and, again, after the great storm of Aug. 19, 1915, he was called upon to recommend still further measures of protection.

His repeated retainer on the seawall problem—a display of confidence in him by the people of Galveston—was due in part to a very shrewd prediction which he had made as a result of his engineering studies of the port problem. The incident is worth repeating as an illustration of General Robert's engineering thoroughness.

In 1889 the President made General Robert a member of a board of engineers to recommend the western Gulf port which the Government should develop to handle the growing tonnage, largely cotton, from the Texas and southwestern hinterland. There was bitter competition. Sabine Pass, Brazos River and Aransas Pass strongly presented their claims.

With a clear vision of the future development of that section—a vision that has long since materialized—General Robert argued that the plans should be laid on broad lines. A 600-ft. channel, 30 ft. deep, he contended, should be the ultimate goal, with shallower waterways on either side, the whole width being about 2,000 ft. and giving a channel cross-section of about 50,000 sq.ft. In addition, the flow should be such that, with the aid of jetties, the channel would maintain itself and save the expense of constant dredging. Galveston alone would meet the conditions. General Robert's studies and arguments were so convincing that his colleagues concurred with him and recommended Galveston for comprehensive development.

Galveston Port Development

There was at Galveston at that time a channel cross-section of about 160,000 sq.ft., but the water over the bar was shallow. That was strongly urged against Galveston by the rival ports, but, despite the opposition, Congress approved the plans and appropriated the money which put Galveston on the map.

Despite the fact that rival delegations failed to prevent the appropriation, discussion did not down and it was freely prodicted that the port of Galveston would never be a success. The jetties were begun about 1890. From then until April, 1895, the depth on the bar had increased only a few feet, giving a channel depth of 14½ ft. General Robert, however, never losing faith in the project, had been studying the soundings with minute care. He found that the bar was steadily traveling seaward and that while the front of the bar had advanced only two miles, the rear had advanced four miles. In other words, the bar was going to sea and at the same time was getting narrower.

In May of 1895 while General Robert was on his way to Galveston by boat the captain expressed the view that 18 ft. of water could never be secured or maintained over the bar. The general promptly predicted that on Dec. 31 of that year, there would be 18 ft. over the bar, and a gain of a least 2 ft. each year until a depth of 24 ft. was reached. He was laughed at and even his colleage, General Comstock, believed that he had made a serious blunder. General Robert had seen, however, from the rate of travel and the lay of the gulf bed, that the bar was just getting into deep water and that the depth over it would soon increase very rapidly.

On Dec. 31 there was 19 ft. of water and for the next three years the depth increased fully as much as predicted.

In addition to his port and seawall work at Galveston, General Robert was called in at various times as consulting engineer on the design of the causeway connecting Galveston with the mainland. In 1911 he was called to the Tropics as consulting engineer to design the improvements to the Port of Frontera at the mouth of the Grijalva River in the State of Tobasco, Mexico.

His literary-engineering activity has included the planning and supervision of a two-volume index to the reports of the Chief of Engineers. These volumes were models of indexing, including under their topical and personal indexes reference to the minutest phases of the works reported on. These volumes have since been superseded by consolidated indexes extending over a longer period.

Robert, the Parliamentarian

But this biography was to have been about Robert, the parliamentarian.

That is true, but being an engineer and writing for engineers, the writer could not refrain from first proving that the subject of this sketch is indeed a professional brother to all of us, thinking in our terms, speaking our language—an engineer, accustomed to scientific habits of thought. In fact, the writer holds that Robert is the better parliamentarian because he is an engineer, for it enabled him to bring to bear upon parliamentary procedure the mind and methods of the applied scientist. To this scientific analysis of his subject is due, we believe, his position as the leading parliamentary authority of this country.

But how did an engineer, pursuing the arduous duties of his profession, come to be the country's leading parliamentarian?

When about twenty-five years old the future general was stationed, as previously recorded in Massachusetts. Unexpectedly, he was called upon to preside at a small gathering. He knew nothing about parliamentary procedure, but while in the chair determined that he should not remain in ignorance thereof. This experience taught him, too, that a knowledge of parliamentary law was a part of the necessary equipment of every educated man.

On searching for information he found only half a dozen pages on the subject, and these in a book of miscellaneous information. He made notes and carried them with him.

Later being transferred to California, he was thrown in with people who had come from every section of the country. Their views on parliamentary law showed a wide divergence in practice. About that time, also, he learned of the existence of Cushing's "Manual of Parliamentary Practice" and of the rules adopted by the Houses of Congress. Study of these, which he immediately secured, showed that they differed much from the practice as he found it, while analysis indicated an absence of accepted principles and many absurdities in practice and in the formulated rules. Particularly did he, with a strong sense of democracy, object to the general adoption of many of the rules of Congress (such as the shutting off of debate by majority vote) which prevent a body from being truly deliberative. These rules, he recognized, were necessary for Congress—a bi-partisan organization with a large amount of work to do—but he believed that they were not sufficiently democratic for the average body, which convenes not to put through party measures but to get at the will of the assembly and to make that effective.

As a result of his studies, he wrote a fifteen-page manual for the guidance of himself and his friends in conducting the deliberative work of charitable, social and civic organizations in which they might be interested.

Then for some years he gave no attention to the subject. Being transferred to Milwaukee and having some leisure during the first winter, he determiend to write a manual that could be used generally and that might aspire to become an authority for the use of legislatures and other official bodies. With his customary energy he bent all his effort to the task. Analyzing each motion and each step of procedure carefully, he tested it by principles which he had concluded were fundamental—these principles being such as would guarantee the deliberative character of the assembly and safeguard the rights of the individual members. As a result of this critical analysis he abandoned much of the procedure laid down in Cushing and the Congressional manual. Basing his rules on a set of principles, they were consistent throughout, and the logical structure and sound basis of the procedure won instant recognition, so that within a few years after the first appearance of the book Robert displaced Cushing and all the other manuals as the standard of parliamentary procedure in this country.

The story of the publication of the original work is an interesting commentary on the confidence of the author in the correctness of his rules and of the persistence with which he was accustomed, and is still accustomed, to pursue that on which he embarks. When he prepared the small pamphlet on parliamentary law, above referred to, he offered it for publication to one of the leading Eastern publishing houses. The manuscript was returned with the comment that there was small demand for such a book. When, therefore, the manuscript of "Rules of Order" was ready he determined to publish the book himself. He bought the paper and personally selected the type in order that the various sections and subdivisions might be thrown in such relief as to appeal to the reader. In fact, the type faces in the hands of the Milwaukee printer who was doing the work proved insufficient to meet his demands and special fonts of type were bought. With this arrangement, since he paid all the bills, he could revise and change as he wished. He continued experimenting until he found a combination of type faces that made the book, in his opinion, as usable as it was possible to make it.

As an indication of how the volume developed, it is interesting to note that even when he put his hand to the actual work of publishing the book only Part I of the "Rules of Order," as we now know the book, had been written. Upon reading the proof of Part I to his wife, she objected that the work consisted only of bare statements of rules, of immense value to one quite familiar with the organization of assemblies and methods of procedure, but quite baffling to one who had never had parliamentary experience. For that reason he at once wrote Part II, which explains how a society is organized and conducted.

Then, when the book was practically all printed, the contest of a member of a religious society against ejection prompted him to hold up the publication in order

that he might write Part III—on the legal rights of an assembly to protect itself.

His original estimate of the demand for the book was such that he determined to have 4,000 copies printed. With one of the bound copies in hand he approached a Chicago publishing house, S. C. Griggs & Co., which has since passed out of existence, with the proposal that they publish it. His suggestion was met by the response from the head of the firm that "It is useless to accept a book on parliamentary law from an unknown author, for Cushing and parliamentary law are synonymous terms. Moreover, what in the world does an army officer know about parliamentary law?"

General Robert met the publisher's rejoinder by pointing out that he was substituting for the somewhat illogical parliamentary law of that day a thoroughly logical structure. Whether that had any effect on the publisher is not recorded, but when the unknown author volunteered at his own expense to send 1,000 copies free to the officers of legislatures, to college professors, law authorities, etc., in order to advertise the book and to secure for it the criticism of competent authorities, the publisher capitulated and agreed to handle the work. General Robert's closing shot on reaching the agreement was that he believed his book accorded more with the American spirit than any parliamentary manual then in existence and that if he was right the experts would commend it; if he was wrong, the book would be condemned and it would be well for himself, personally, if he quickly found out the attitude of those who professed to know something about parliamentary law.

The book appeared Feb. 19, 1876, and such was its success that by July 1, of that year, the remainder of the 4,000 volumes, which had not been used for propaganda purposes, were sold by the publisher. In fact, within six weeks of the publication date the reception had been so favorable that the publisher was clamoring for "copy" for a revised edition. Parliamentary authorities in every part of the country poured upon the publisher commendations of the new work, while the reviewers, with one lone exception, welcomed it as a tremendous step forward in parliamentary practice.

The author's faith in his work had been justified. From every side came commendation of the principles Robert had laid down for safeguarding the deliberative character of assemblies. His maxim that "We are here to get at the will of the assembly" had met instant response.

Year by year the sale of the volume increased so that by the end of 1914 over 500,000 had been printed and sold.

The volume was revised in May, 1915, under the title of "Robert's Rules of Order, Revised." As an evidence of General Robert's thoroughness, it should be recorded that he worked three years on this revision. There were no fundamental changes from the first book, but the text was clarified, the order changed so as to make reference easier, and the work greatly enlarged.

For some years now he has been working upon a new book on parliamentary procedure. Unlike "Rules of Order," it is to be not a mere statement of rules—a codification—but a readable volume that will show by examples how a deliberative assembly is organized, how motions are put, etc. The former work is a ready reference book for those already familiar with parliamentary procedure, while the latter is to have an educational character and a readable style. The new work takes up each class of motion or procedure separately, explains the circumstances requiring its use, its effect, its limitations, privileges, etc., and the reasons for according the motion or procedure its privileges or for hedging it about with limitations. In addition, it will contain answers to some 250 questions that have been submitted to General Robert by presiding officers of assemblies and societies, by teachers of parliamentary practice, etc., together with the answers thereto.

The text of the new book is now pretty well along and promises to make a volume of large size. General Robert will be content with nothing short of completeness, and to that end has already put some five years on the work.

Robert, the Man

So much for the engineer and the parliamentary authority.

What manner of man is this who has achieved the topmost place, as Chief of Engineers, in his vocation, and has also become the country's leading authority in his avocation?

Energetic, strong in mind and body; heaped with honors, but nevertheless extremely modest; enthuiastic, interested in the events of the day; a sane optimist, and, above all, a sterling character.

The writer well remembers his first meeting with General Robert. We were seated on the piazza of the Hotel Galvez, at Galveston, while a spice-laden breeze from the tropics came in over the sea. The general had been introduced as the engineer of the sea-wall work. For an hour he told the sea-wall story, from the day of the original Robert-Noble-Ripley report.

Then, knowing that his listener, through his editorial capacity, had contact with publishing, he began to inquire about the sales' experiences of book publishers. He had, he remarked, written a "little book" quite a few years ago and had recently finished a revision. The listener was astonished at the sales of the volume. Most books have a very short life. They blossom to fullness in a year or two and then gradually drop back into oblivion, the sales decreasing year by year. But here was a marvelous work. According to the speaker, its sales had increased from year to year for 40 years. There had never come a slump. What was this marvelous volume? For a half hour or more, in which details of book publishing were discussed, the name of the volume was never mentioned, the listener's curiosity rising at each sentence. Was it a religious book? Some of them had had remarkable records. If not a religious book, what could it possibly be?

Finally curiosity overcoming discretion, and possibly courtesy, the question was asked, "What is the title of the book?" So this man, eminent as an engineer—eminent above all others in the science of parliamentary law, was too modest to reveal his identity until he was forced to disclose it. And yet it is characteristic of the man.

Today, despite the fact that his eighty-third birthday is nearing, the general is hale and hearty—his mental powers undiminished, his physique still equal to fairly hard work. In conversation, whether arguing, expounding or reminiscing, he habitually sits on the

edge of his chair—a trait characteristic of the enthusiasm and energy he puts into all he does. He writes interestingly, on Oct. 11, of last year, about that which was then engaging his attention:

"My friends tell me," he says in a letter, "that they have never seen me looking better. I presume it is due to my physical work this summer. We bought a house here last March and have been at work remodeling it for six months, sometimes with nine carpenters, masons, plasterers, plumbers, etc., at work, at the same time. As the work has been done by day labor, it required constant oversight, especially as the architect lives in Binghamton. We have been living in the house since July 10, though the painters did not finish until a few days ago. It will be another month before we have our pictures and books out of storage and arranged."

And then he continues with much detail to tell, by contrast, of his mental work—the writing of the new book.

Such occupations are assurance that he is still, at 83, vigorous in mind and body.

We know that all his professional brethren join with us in wishing many happy years to this honored member of the profession, this modest gentlemen who has stood for more than a generation as the leading parliamentary authority of this country. E. J. M.

City Planning Progress in Detroit

Activities of the City Plan Commission of Detroit, Mich., created under the new City Charter that went into effect on Jan. 1, 1919, include plans for a number of important street widenings, a boulevard encircling the city, material additions to the parks and the playgrounds of the city, and much preliminary work on zoning. The various activities of the new commission from the time it got to work on March 1 to Dec. 31 are reviewed in a brief report submitted to the City Council.

It may be noted that for ten years prior to Jan. 1, 1919, there existed in Detroit a City Plan and Improvement Commission created by ordinance in 1909. This commission had only advisory powers. Nevertheless its work, according to the report of the new commission, "included many creditable ideas and plans for the improvement and betterment of the city." Among these were studies for a general city plan of Detroit and environs by Edward H. Bennett of Chicago and plans and recommendations for river front improvement, a lakeside boulevard, and several parks and playgrounds. The new commission has various specific powers and duties as set forth in Chapter X, Sections 1-12 of the new charter of the city of Detroit.

In its nine months of existence the new commission made studies, plans, and recommendations for opening, widening or extending 68 streets and thoroughfares. Among these were the Dix-High-Waterloo thoroughfare across the entire city; widening of Michigan Ave. to 100 ft., and Livernois Ave. to 106 ft.—these three for various distances. During the nine months the commission acted favorably on 31 plats for street and lot layouts. Under the new charter the commission must approve not only all new plats within the city of Detroit but for three miles outside the city limits before they can be officially put on record.

After investigation and recommendation by the commission a $10,000,000 bond issue for park and recreation purposes was placed on the ballot in April, 1919, and endorsed by popular vote. Additional lands for park purposes recommended by the commission during the year and ordered condemned by the common council totaled 1,745 acres against 1,235 acres for the total area of Detroit's parks on Jan. 1, 1919—an increase of 141 per cent.

In the zoning field the commission made study maps for use, height and area districts, together with valuation, industry and railroad, population density, population distribution, residence location, vacant area and building development maps. At the close of the year the commission was working on tentative final zoning maps for use, height and area districts.

The commission has issued two special reports relating to a proposed constitutional amendment authorizing the practice of excess condemnations in Michigan. The legislature has passed an act under the terms of which such an amendment will be submitted to popular vote of the State in November, 1920. James S. Holden is president and T. Glenn Phillips is consultant and secretary of the City Plan Commission.

A Billion for Road Work Possible

According to figures recently compiled by the Portland Cement Association, a summary of state and county bond issues for road-building purposes as of March 1, 1920, indicates that there was authorized during 1919 and so far in 1920, $635,641,729. For the remaining months of 1920, elections in the states and counties of the states are to be held which will determine whether an additional $391,253,800 is to be appropriated for road-building purposes. Therefore, the total, including the amount of money authorized and that proposed, is $1,026,895,529. Most of the elections, proposing additional state expenditure, will be held in November. The following chart, which indicates the distribution of proposed and authorized money by state and county, contains a few issues which were voted late in 1918, but from which little money has been taken for actual construction:

State	Amount Authorized		Amount Proposed	
	State	County	State	County
Alabama	$25,000,000	$5,000,000	.....	.....
Arizona	.....	8,800,000	.....	.....
Arkansas	.....	4,900,000	.....	.....
California	40,000,000	28,435,000	.....	$1,400,000
Colorado	.....	.....	$25,000,000	.....
Delaware	.....	500,000	.....	.....
Florida	.....	2,615,030	.....	.....
Georgia	.....	15,375,000	.....	.....
Idaho	.....	7,873,000	2,000,000	.....
Illinois	60,000,000	9,052,845	.....	4,100,000
Indiana	.....	860,000	.....	.....
Iowa	.....	18,475,000	.....	.....
Kansas	.....	50,000	60,000,000	.....
Kentucky	.....	2,830,000	.....	.....
Louisiana	.....	8,267,000	.....	.....
Maine	8,000,000	.....	.....	.....
Michigan	50,000,000	3,100,000	.....	550,000
Minnesota	.....	12,800,000	100,000,000	.....
Mississippi	.....	15,848,000	25,000,000	.....
Missouri	.....	15,119,600	60,000,000	2,550,000
Montana	.....	6,283,000	15,000,000	850,000
Nebraska	.....	3,000,000	.....	.....
Nevada	1,000,000	200,000	.....	.....
New Mexico	.....	200,000	2,000,000	.....
North Carolina	.....	13,459,635	.....	.....
Oklahoma	.....	1,297,000	.....	1,400,000
Oregon	12,500,000	9,516,704	.....	2,000,000
Pennsylvania	60,000,000	16,217,945	.....	3,064,500
South Carolina	.....	8,560,000	.....	.....
South Dakota	.....	.....	.....	2,000,000
Tennessee	.....	7,385,000	.....	700,000
Texas	.....	88,708,000	.....	1,250,000
Utah	4,000,000	2,766,000	.....	150,000
Washington	.....	9,535,000	30,000,000	512,000
West Virginia	.....	8,426,000	50,000,000	1,727,300
Wisconsin	.....	36,887,000	.....	.....
Wyoming	2,800,000	.....	.....	.....
Totals	$263,300,000	$372,341,729	$369,000,000	$22,253,800

Planning Transit Development in Cleveland

By Henry M. Brinckerhoff,
Consulting Engineer, New York City

A simple techincal statement of the case for the proposed terminal subways for street cars, by the engineer who planned them. While these subways have the main function of relieving street congestion by taking many of the down-town cars off the streets, they are also intended as the initial element of a future rapid-transit system. In preparing for the bond-issue referendum on the project, to be voted on April 27, the city authorities have featured the proposed system as a beginning of rapid transit. Mr. Brinckerhoff tells why it is "A First Step in Rapid Transit."

THE plans for a Rapid Transit Commission of Cleveland for a group of short terminal subways for street cars, leading to loop stations under the Public Square, are now before the people of that city for consideration and will be voted upon at the election April 27. These plans [summarized in *Engineering News-Record* of July 24, 1919, p. 170,] call for a bond issue by the city of $15,000,000, most of the interest on which is to be spread upon the general tax levy. The Cleveland Railway Co. is to operate the car service in the subways under an agreement with the city which is essentially the Tayler-Cleveland street railway plan enlarged to cover this new service. The company will pay the interest on the tracks and electrical and other equipment in the subway, while the city will own the structures themselves, pay the interest thereon, and control the train and car service under the Tayler plan of regulation.

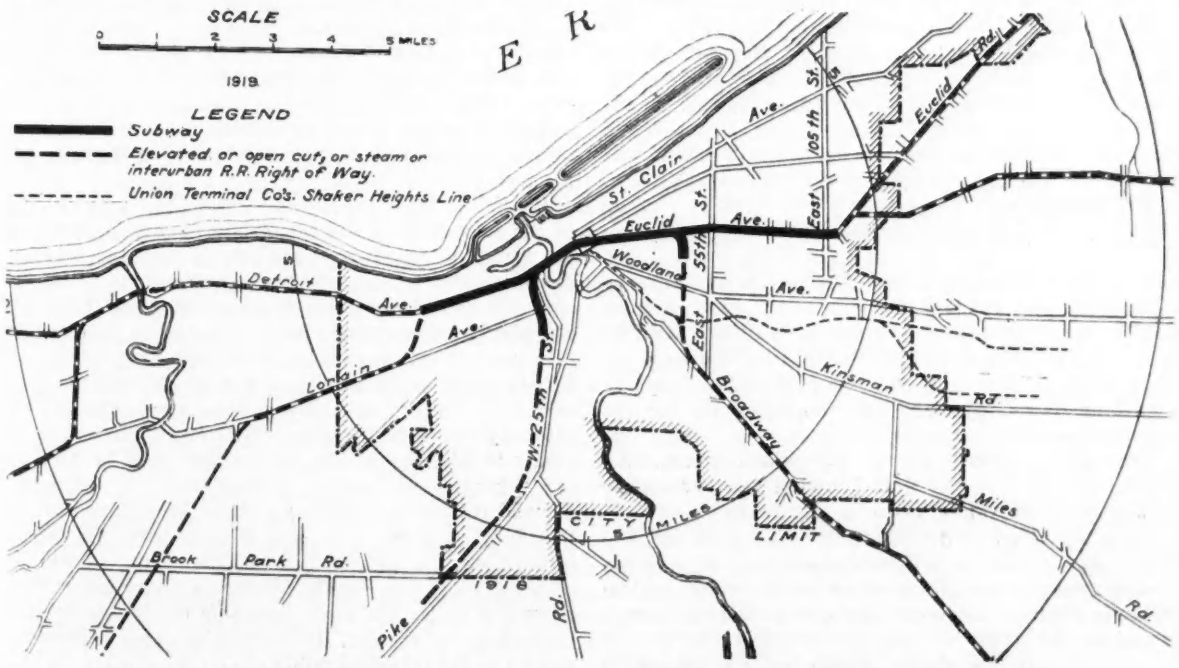
An interesting question arises in this connection as to the principle underlying the construction of short sections of subways in the center of the city as a "first step toward rapid transit" as is stated in the commission's announcements. In the following the writer presents a brief statement of the basis of the plan and the warrant for the phrase just quoted.

Rapid Transit Needs—Cleveland has just reached the point where its metropolitan district houses one million people. Cities which have passed this mark, such as Philadelphia, Chicago, Boston and Brooklyn, commenced the development of rapid-transit systems when they were at or near one million in population. The general public demand for a rapid-transit serivce is therefore normal as viewed from the standpoint of experience and the development of cities which in population and area have grown to perhaps twice the size of Cleveland today.

Unified Transit—In studying the larger cities from whose traction history and present condition certain valuable lessons can be learned, we must remember that their surface and rapid-transit lines were built under private initiative and on a competitive basis. Much of the trouble lying at the bottom of the present public complaints of inadequate service is due to the practical financial difficulties of earning fixed charges upon the investment in duplicated and competing lines. This coupled with a natural public demand for a low rate of fare exaggerates the effect of the economic waste of two competing systems as against one unified consolidated set of transportation lines.

From the viewpoint of the car riders the ideal system in a large city would be one giving the freest possible use of all lines, surface and rapid-transit, by universal transfer of passengers and the arrangement and co-ordination of each class of service to completely cover and serve the constantly broadening city area.

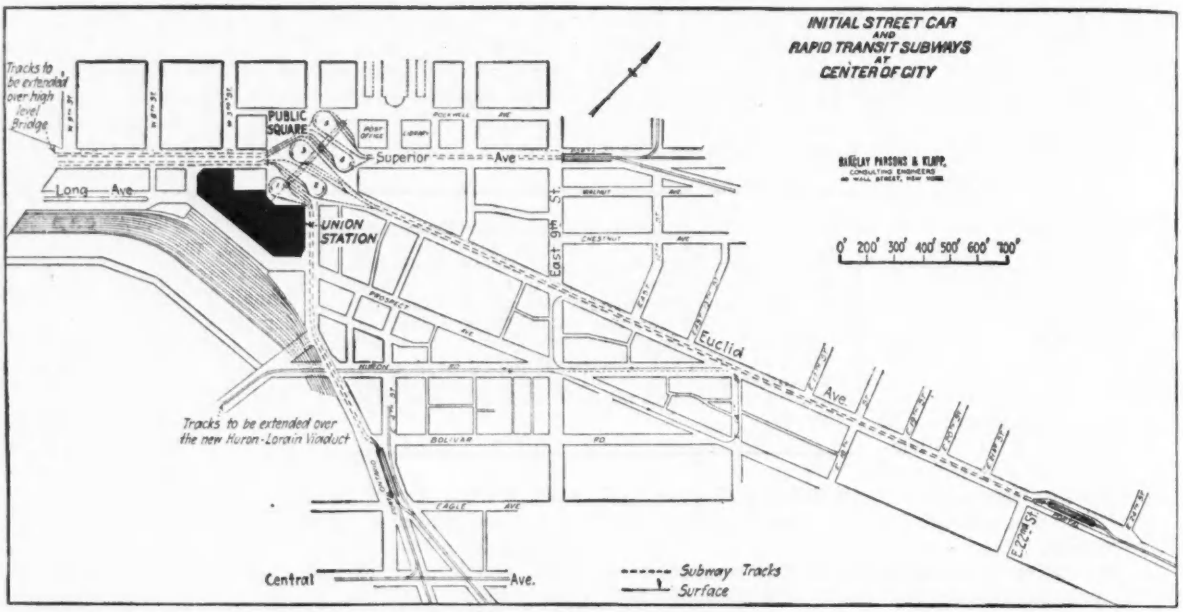
No Duplication of Lines—An effort to produce such a co-ordinated system in the larger cities today



RAPID-TRANSIT SCHEME FOR CLEVELAND: A SINGLE TRUNK LINE WITH FEEDER BRANCHES

develops at once the fact that there is a considerable duplication both of physical structures and investment, as the tracks and equipment are in places in duplicate and often parallel, due to their competitive origin. If these tracks and systems could be completely wiped out and a carefully planned unified system substituted the city is east and west parallel with the lake shore, and passes through the Public Square.

The principal surface-car lines entering this central district, will under the proposed plan be run down into the subways before reaching the congested area. The result will be that with the wide streets comparatively



RECENT PROJECT FOR TERMINAL SUBWAYS FOR STREET CARS, INTENDED AS A FIRST STEP IN RAPID TRANSIT

the rapid transit trunk lines could be used for the congested and long-haul business and the surface cars run as feeders to these trunks to accommodate the strictly short-haul traffic. Thus, much better accommodations could be afforded the public at less original cost and at a lower operating expense.

Given a city like Cleveland, therefore, without any rapid-transit development, and looking to a future city of perhaps twice its present size, it is reasonable to propose to so plan the initial steps of the rapid transit lines as to avoid the obvious shortcomings seen in the dual competitive systems found in our larger cities. The fact that Cleveland has controlled its street car service for the past ten years under the direction of a city commissioner makes easy the task of dealing with the practical operating questions of such a combined service.

With the present high cost of materials and labor in all construction, and with the propasal to expend public money upon permanent structures without thought of profit, the obligation lies heavily upon the engineer to plan the system so as to make each dollar build the maximum of facilities and the design provide for the greatest economy in running costs.

The plan proposed by the Cleveland commission attacks the problem by first bringing the surface-car lines to their maximum capacity and usefulness.

Relieving Downtown Congestion—The principle difficulty with the existing Cleveland surface-car lines lies in the congested condition of all traffic in the central business district. Forty-five per cent of the passengers riding on the street-car lines entering this district ride to or through the Public Square or its immediate vicinity. The greatest volume of long haul traffic in unobstructed in the outlying sections and with the cars in the subway in the congested districts, a very much more regular and higher speed service will be rendered than at present.

The elimination of congestion in the Public Square district during rush hours will not only save a certain amount of time for the rider, but make it possible to load fully the outlying tracks, which now have greater capacity for car movement than can be passed through and loaded in the Square and congested delivery district. This will therefore result in making it possible to run many additional cars, with consequent greater comfort to the public and greater earning capacity for the system.

Provision for Through Routing—The arrangement of the subway tracks in the Public Square is such that the radiating street-car lines can be operated independently from this point in various directions or can be conected up and run through across the city. The loading platforms, switches, loops, etc. are so designed in this central subway transfer station as to permit through routing of a part of any of the surface lines and the turning back of the unbalanced portion. In this way the usual practical objection of through routing is avoided, as no idle car mileage need be run but the through cars can be proportioned to the actual demand for through service and the heavier end of the line fully supplied with cars without running useless mileage on the lighter side of the city. It will be admitted that this should produce a street-car system operating under the most favorable conditions for the rendering of regular, uninterrupted and high-speed service to the traveling public.

Future Train Operation in Subways—The question

of rapid transit is answered by designing the sections of the subway, the loading platforms, curves, loops and all clearances so that trains of standard rapid-transit cars can be run through these subways. The development of separate rapid-transit train service on any one of these lines can then be accomplished by extending any one of the five radiating subway sections far enough to warrant such service.

It is contemplated that it may be possible to connect the present short subway sections to elevated lines, or to lines on private rights of way or even to use some of the steam railway lines to reach the outlying districts. The present subway construction is therefore literally a *first step in rapid transit.*

Co-ordinating Subway and Surface—If one of the present short sections is extended, as for instance the Euclid Ave. section, for several miles, train service can be placed in this subway and a limited number of street cars continued to be operated upon the street-car tracks directly above. As this plan contemplates a unified system operated by the same company and under city control, transfers can be given from the rapid-transit line to the street cars by vertical transfer at station points. The subway trains will then perform the function of express service and the street cars on the surface tracks above will operate as local service, making frequent street corner stops. The subway trains will stop only at stations spaced at about one-third mile intervals. In the building of further street-car lines or in the re-routing of the existing lines, further development of this idea can be obtained by running cars directly to certain stations on the extended subways where transfers can be given to the trunk or rapid-transit subway trains.

Thus it is planned to develop a system which will produce a thoroughly co-ordinated development of surface and rapid transit lines.

Economy of Co-ordination.

It is interesting to note in this connection that cities such as Chicago, Boston, Brooklyn and Philadelphia have from $95 to $110 per capita invested in their combined surface and rapid-transit lines. A study of a plan for a city such as Greater Cleveland when it shall have grown to a population of 2,000,000 indicates the possibility of developing a satisfactory trunk-line rapid-transit system giving transfers to a surface system with radiating or crosstown street car lines at from $70 to $75 per capita.

The economic value of locating and building the rapid-transit lines so as to utilize effectively the street car lines to their maximum capacity as feeders, and for local hauls, is obvious. This will avoid the evil of competing lines and effect a great saving in investment, while at the same time keeping the whole system under one management and city control.

Boston Conditions—The objection made by those familiar with the transportation system of Boston that a similar plan in that city resulted in high rates of fare and excessive investment per capita misses the very essence of the proposed Cleveland rapid-transit plan. The Boston system started with street-car subways in the downtown district but the subsequent development has been allowed to run into the excessive building of expensive rapid-transit subways and tunnels. The high cost is partly due to the separation of the various parts of metropolitan Boston by waterways requiring long subaqueous tunnels. Narrow and crooked streets have made difficult the full development of surface-car lines. In Boston also the interest charges are all carried by the car riders.

In Cleveland with its wide streets and with only its single river and valley separating its principal metropolitan area, no excuse arises for such great expenditures in subway and tunnel construction. The commission's plan also provides for relieving the street car passenger by spreading the fixed charges largely on the tax roll.

A Hub Built First—The rapid-transit commissioners' plan in Cleveland will in this first step create a hub with radiating spokes, any one of which can be developed by extension into the outlying districts of the city. The extension of any one line must depend upon the traffic development in the district such as to warrant the extended building of the permanent rapid-transit structures and the operation of trains.

"The First Step in Rapid Transit" is therefore a justified expression as the development of this system is planned. It is proposed to attack first the most vital difficulty confronting the city, namely, that of congestion and delays to the existing service. Outlying rapid-transit lines not traversing this downtown district and leaving the street-car lines choked and throttled by vehicle traffic would not be a justifiable first step. More of Cleveland's own citizens will be benefitted by the present proposed first step than by the expenditure of an equal amount of money in a single competing rapid-transit line in any one of the various radiating directions followed by its main thoroughfares.

A Common Weakness of Reports

The February, 1920, *Bulletin* of the Affiliated Engineering Society of Minnesota contains a paper on municipal engineers' records and reports, prepared by H. F. Blomquist, principal assistant engineer St. Paul (Minn.) Water Department. From his paper, which was read before the Minnesota Surveyors and Engineers' Society, are taken the two paragraphs which follow:

A common weakness in reports is to detail unimportant things and leave out the conclusions or results obtained and other important things. It is not important how much the street department paid to Tom Jones or Sam Smith in payrolls during the past year, but it is important how much of the payroll was spent for cleaning streets, paved and unpaved, and ho wmuch street cleaning cost per square yard, how much was spent for street sprinkling, how much for permanent work, such as building culverts, sidewalks, pavements, etc. Almost every good thing can be overdone, and reports are not to be excepted.

In making a report its purpose as well as the viewpoint of those to whom it is to be made should be kept in view. Too much detail work included in a report confuses the reader and often prevents him from grasping the value of part of it. For example, it would be undesirable to include in the published annual report all the readings and detail description of a test for the efficiency of a steam or electrical pumping plant, or measurements and data taken for determining the strength and condition of a bridge; but it is important to give a general description such test or examination, and a clear statement of the results obtained. The detailed description and data connected with such work should be carefully included in a special report for the office files, and other necessary requirements.

Railway Reclamation of Damaged and Old Materials

Scrap Saved, Sorted and Put in Condition for New Service—Engineers in Charge of This Work on Rock Island Lines

(Abstract of Committee Report, American Railway Engineering Association)

WIDER realization of the advantages of reclaiming and utilizing scrap material has been impressed upon the railways by war conditions and such reclamation was one of the subjects covered in the report of the committee on natural resources, presented at the recent annual meeting of the American Railway Engineering Association. It is shown that many railways have gone so far as to erect shops equipped with special appliances for working over at small cost much of the worn and damaged material that formerly went into the scrap pile.

Rails with split and battered ends can be sawed into shorter lengths and used again; worn and broken frogs and crossings, switch points and rail ends can be built up and welded, many of them in place, by means of the oxy-acetylene welding torch; worn and bent anglebars can be swedged into their original sections by means of a drop-hammer. By oiling track bolts at regular intervals the bolts can be kept tight, with a saving in labor and in wear on angle-bars and rail ends, while in rail renewal work it allows many bolts to be reclaimed that would otherwise find their way to the scrap pile.

Many roads are finding the sawmill a useful agency in the conservation of timber. Old stringers and other large timbers can be sawed so as to recover a great deal of valuable lumber. Much of the lumber that is being used for signs and crossings might be conserved by substituting other materials more permanent and in many cases no more expensive than wood. For example, the report suggests that an old boiler tube set in concrete and flattened at the upper end to receive a steel plate makes an attractive sign that requires very little expense for maintenance.

Salvage Possibilities in Lumber

Ties can be utilized for cribbing or fuel and some from the main track can be used in yard tracks and sidings. Elm and maple pile-heads can be sawed and turned into jack and cant-hook handles; oak pile-heads can be sawed into center and ballast stakes; while cedar pile-heads can be sawed into shingles. It frequently becomes necessary to renew certain timbers in wooden structures, even though only a very small portion of the member removed fails. These can be worked into usable sizes for other purposes.

A reclamation plant established by the Rock Island Lines at Silvis, Ill., is an example of systematic attention to this question. It has a scrap dock 48 ft. wide and 1,500 ft. long, with six bins 28 x 42 ft. for storing unsorted scrap, eight bins 28 x 30 ft. for sorting scrap and 74 bins of various sizes for sorted scrap. Three traveling gantry cranes of four and ten tons capacity have lifting magnets for 1,500 and 8,500-lb. loads. A shop 25 x 270 ft. contains a 100-lb. hammer, two 150-lb. power hammers, double and single alligator shears, bolt shear, rattler for cleaning, drill press, nut tapping machine, four electric welders, four oxweld outfits, air-operated shear and air-operated punch.

Reclamation of material on this road is handled through a committee consisting of the chief engineer (as chairman), purchasing agent, general mechanical superintendent and general storekeeper. Each operating division has a sub-committee consisting of the division engineer (as chairman), master mechanic and division storekeeper. These sub-committees hold monthly meetings at which new items of reclamations and progress are discussed, after which a report is made to the general committee. It is the duty of these sub-committees to see that scrap is promptly collected and shipped to the plant, each division being assigned a certain shipping day or days during the month in order to prevent overcrowding of the plant at Silvis. In addition to supervising the handling of materials, they have done much toward promoting the reclamation idea on their divisions and encouraging the study of uses for reclaimed materials.

Material that can be reclaimed on each operating division is used by that division, thereby avoiding the congestion which would otherwise occur at Silvis. All material is sorted into three classes: Scrap for sale, material fit for further use, and material to be repaired for further use. One factor in reclaiming material is that of safety, as every item reclaimed is put in perfect condition.

Bolts and nut locks were reclaimed during one month to the amount of $599, at a total cost of $89; thereby effecting a saving of $510. In the same time 27,065 lb. of nuts of various sizes were reclaimed by sorting and retapping at a net saving of $72. About 1,743 lb. of lag screws were reclaimed by rattling until bright as new, at a saving of $133.

This plant is doing such work as welding cast-iron spokes on driving wheels; building up worn spots on firebox castings with acetylene welding; mating and pairing flange worn steel-tired wheels before turning, thereby saving a great deal of labor; reclaiming salt deposits from refrigerator cars for use in thawing switches during the winter and for use in fire barrels; pressing oil from waste (one barrel of waste netting about 20 gal. of oil); burning the waste and reclaiming about 50 lb. of babbit (this reclaimed babbit is as good as new); reclaiming barbed wire for use in building rip-rap. The systematic reclamation work on the Rock Island Lines was noted in *Engineering News-Record* of Feb. 5, 1920, p. 289, in connection with the reconstruction of the Platte River bridge.

Light Colors Advocated for Bridge Paints

LIGHT-COLORED paint for the finishing coat on steel structures, on the score of efficiency and appearance, was advocated at the annual meeting of the American Railway Bridge and Building Association by J. R. Shean, of the Pacific Electric Ry., Los Angeles, Cal. Unless the price of material is the main consideration he sees no reason why steelwork should not be painted in light colors, since their resistance to heat rays, as compared with dark colors, would be easier on the oil film which holds the pigment together.

Canary yellow, pearl gray or light olive green will change an unsightly black structure to one that will be at least more in harmony with the surroundings. These light colors, says Mr. Shean, will have a sufficiently longer life than the dark colors to pay for any difference in cost. It may be argued that light colors become unsightly in a short time from dirt and smoke. This

cannot be noticed to any extent, he thinks, except overhead on through truss bridges and on overhead bridges, but even with black paint the smoke marks show conspicuously here.

As supplementing Mr. Shean's remarks, reference may be made to the experiment with a pale buff color for the Loop elevated railway in Chicago, this being made at the request of the merchants on the streets occupied by the structure, as noted in *Engineering News* of Oct. 2 and Nov. 20, 1902, pp. 264 and 429. The effect in brightening the streets was remarkable, but soot and dirt which collected on the upper portions and mud which spattered the columns soon began to mar the appearance of the structure, so that it was eventually repainted the original dark gray.

Kansas City Water-Works Capacity To Be Increased

WITH improvements and additions now under way the water supply of Kansas City, Mo., is expected to be increased from 50,000,000-gal. capacity to 80,000,000 gal. This amount, the officials estimate, will be good for about seven years only. The existing sites, reservoirs, stations and flow lines cannot easily be extended beyond this capacity without wholesale revamping. In consequence George W. Fuller, consulting engineer, New York City, has been called in to review the whole situation and will study every possible means of obtaining water which have been proposed in the past in the light of present-day conditions and future requirements.

For immediate improvements he has practically approved the program under way, consisting of additional pump capacity well along toward completion at the Quindaro and at Turkey Creek stations, of an additional flow line between the two stations, baffling of certain of the reservoirs, and a few changes in operation to increase the efficiency of the settling basin.

Future water supplies may be obtained through the present intake at Quindaro, but the head is such that if filters are constructed an entirely new layout of station and reservoirs must be effected. Other serious objections are that the river channel tends to recede from this bank in floods and that the works are in Kansas, with present taxes of $35,000 paid on full valuations. Future expenditures when made would carry taxes so heavy that the money rate would be augmented from 4½ per cent on bonds to 6½ per cent or more by the taxes. Some salvage should be obtained of the existing plant by turning over to Kansas City, Kan., which has its plant adjacent to Kansas City, Mo. A second proposition is to build an entirely new system across the river on the Missouri side, where the bank is ledge rock and the channel stable. Taxes would thereby be eliminated. This would probably have several alternatives because of the possibility of different sites for filters and reservoirs. It would involve a difficult crossing of the river by bridge, pipe lines or tunnels. The third proposition, never seriously considered by engineers, is to go 150 miles to the Ozark Mountains for spring water.

Data are now being collected by the water department for Mr. Fuller under the direction of W. G. Goodwin, engineer and superintendent. It is expected this will require two months, when a preliminary report may be made. A final report will be presented in August and used in a campaign of education for financing whatever scheme is proposed. The State Legislature will have to grant an extension of the bonding limit of the city and then would come another campaign to induce the citizens to vote the bonds. This part of the program is estimated to require two years. Add a construction program of five years and the city would be brought close to the limit of the capacity of the existing plant.

Red Cross Sanitary Survey in Eastern Europe Outlined

At the first annual conference of the General Council of the League of Red Cross Societies, held at Geneva, Switzerland, March 2 to 10, 1920, Prof. George C. Whipple, chief of the Department of Sanitation, a branch of the General Medical Department, and his associate, Col. F. F. Longley, presented an outline of proposed activities. These, Professor Whipple informs *Engineering News-Record*, include sanitary surveys in Eastern Europe to be undertaken with three principal objects: (1) To ascertain the facts as far as they are available; (2) to demonstrate the value of sanitation to the community; (3) to serve as the basis of public health measures and appropriations. It is expected that the surveys will be conducted jointly by sanitary engineers and physicians.

The sanitary surveys will be conducted in seven parts, as follows: (1) The Locality; (2) Climate; (3) People; (4) Vital Statistics; (5) Sanitation; (6) Health Administration; (7) Special Survey Information. Under sanitation there are the following 12 main sub-divisions: (a) Water Supply; (b) Drainage and Sewerage; (c) Disposal of Human Excreta; (d) Use and Disposal of Animal Manure; (e) Refuse Disposal; (f) Disposal of the Dead; (g) Sanitation of Buildings; (h) Sanitation of the Air; (i) Control of Animals and Insects; (j) Food Sanitation; (k) Sanitation of Transportation Facilities; (l) Miscellaneous Sanitary Matters.

To Classify British Roads

At the first meeting of the Roads Advisory Committee held at the [British] Ministry of Transport, Whitehall-gardens, Feb. 5, the proposals of the Minister of Transport with regard to the classification of the roads of the country were submitted in the form of a memorandum. The committee agreed that the work of classification should be undertaken at once, and approved of the following general principles: (1) The roads of the country to be divided into three classes: (*a*) First class, (*b*) second class, (*c*) all other roads. (2) The classification to be made on the basis of the relative importance of the various highways for traffic purposes. In deciding whether a road should be included in Class 1 or Class 2 the following considerations should be taken into account: (*a*) Whether the road was an important route for through traffic or possessed more than local importance; (*b*) the size and importance of the centers of population connected by it; and in particular (*c*) whether the cost of maintenance was considered to be materially affected owing to through traffic forming a substantial percentage of the total traffic on the road.

While the committee agreed to recommend that grants from the Exchequer should take the form of contributions toward the maintenance of roads in Classes 1 and 2, it postponed making any recommendations as to the form the grants should take until more precise information could be supplied with regard to the funds likely to be available, and the mileage and cost of maintenance of roads to be included in Classes 1 and 2.—*The Engineer.*

Progress on New Orleans Inner Harbor—Navigation Canal

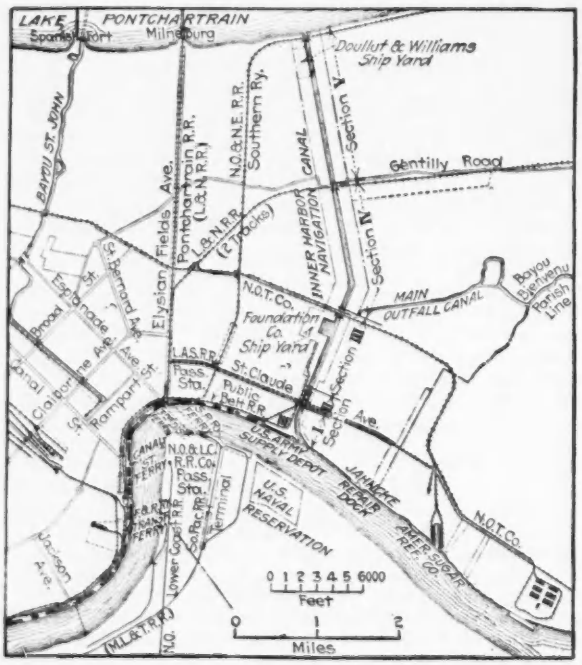
Practically All Excavation Complete and Bridges Erected—Lock Excavation Unwatered and Concreting Started

By Marshall G. Findley
Assistant Designing Engineer, Board of Commissioners of the Port of New Orleans, New Orleans, La.

CONSTRUCTION of the New Orleans Inner Harbor—Navigation canal, connecting the Mississippi River with Lake Ponchartrain, has progressed favorably since its initiation in 1918. The work is now considerably more than half completed, the principal remaining tasks being actual construction of the lock and cutting the approach from the river.

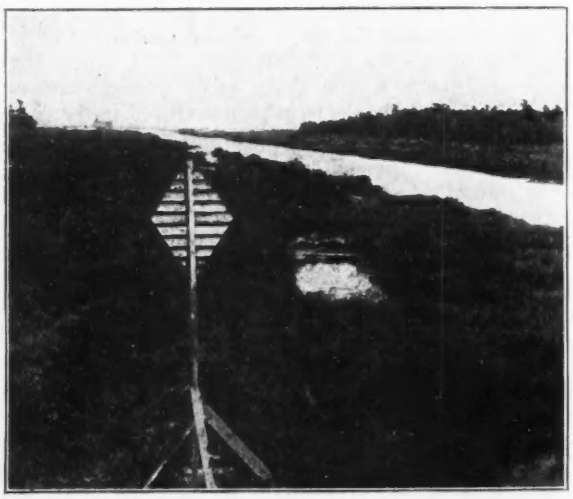
As described in *Engineering News-Record*, Aug. 15, 1918, p. 304, the work consists of a deep canal connecting river and lake, with a level maintained at that of the lake, El. 20 to 26, zero of which is approximately 20 ft. below mean low water in the gulf (Cairo datum), by a lock separating that level from that of the river, which varies from El. 20 to 39. It is approximately 28,000 ft. long, will have a depth of 30 ft., a bottom width of 150 ft. and a water level width of 330 ft. The lock has a usable length of 640 ft., a width of 75 ft. and a depth over sills of 30 ft. There are four lift bridges crossing the canal, one of which will be supported on the lock substructure, and a large concrete siphon carrying one of the city's main drainage outlets. The estimated cost of the project is $19,500,000, which should cover all charges, property, dredging, construction plant and operations, financial charges and damages.

The canal is divided for convenient reference into five sections. Beginning at the river, section 1 is approximately 2,000 ft. in length, and will have on either side continuations of the river levees, 23 ft. above low water and a channel 125 ft. wide by 30 ft. deep at low water. Section 2 is the lock. Section 3, from about Sta. 31 to about Sta. 87, includes the siphon and the Florida Walk bridge. Section 4 is from about Sta. 87 to Sta. 175, and includes the Louisville & Nashville Bridge. Section 5 is from about Sta. 175 to Sta. 277 and includes the New Orleans & Northeastern bridge.



NAVIGATION CANAL BETWEEN MISSISSIPPI AND LAKE PONTCHARTRAIN AT NEW ORLEANS

The work already accomplished may be roughly divided, as follows: Location and soil examination, dredging, constructing and unwatering caissons for substructures, construction of the siphon, construction of three bridge substructures, erection of the three bridges, preparation of the lock site for the actual work of construction. Of the preparatory work little is worthy of mention. Borings made with a 2-in. pipe proved worthless, but a 10-in. pipe, driven 3 ft. at a time and excavated before further driving, gave trustworthy results. Borings from 40 to 90 ft. long made in this manner gave the necessary information for constructing the various caissons and for unwatering the lock site.

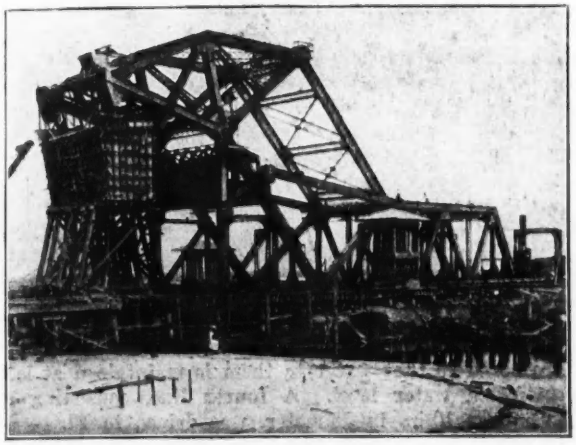


CANAL AT LOUISVILLE AND NASHVILLE BRIDGE

No attempt has been made to dredge the full length of channel to finished section, but sufficient work has been done to make every portion of the canal accessible. In section 3 from the lock to the siphon at Florida Walk, a stretch of 5,500 ft., a channel 130 ft. wide and 24 ft. deep has been cut and also the turning basin for the shipyard of the Foundation Co., a total of 1,353,000 cu.yd. of excavation. In section 4, from Florida Walk to the Louisville & Nashville Bridge, a distance of 8,800 ft., a channel 100 ft. wide and 24 ft. deep has been completed, requiring 817,000 cu.yd. of dredge excavation. In section 5, from the L. & N. bridge to Lake Ponchartrain, a distance of 10,000 ft., a channel 20 ft. x 140 ft., supplementary work for the shipyard of Doullut & Williams, and the necessary dredging in the lake to give a 14-ft. channel depth, have required 1,870,000

cu.yd. of dredging. In section 2, the lock site excavation, amounting to 582,000 cu.yd., has been accomplished by hydraulic dredges.

Altogether five dredges of the centrifugal type have used. A large part of the canal runs through an old swamp forest of gum and cypress. Under the root mat of this forest were found the stumps of an older forest. For 15 ft. below the surface the soil was practically a solid mass of roots and stumps. Some were partially



ONE OF THE BASCULE BRIDGES ACROSS THE NEW ORLEANS INDUSTRIAL CANAL

decayed, but most were in good state of preservation. The condition thus described at first seemed impossible for hydraulic dredges, but the conventional pump runners were discarded by W. J. White, the dredging superintendent, and special runners substituted with great success.

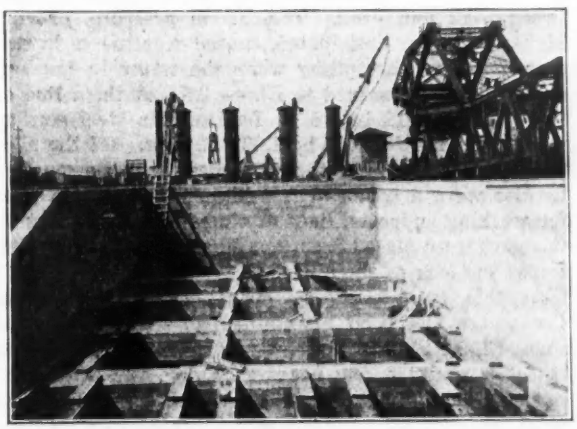
[A description of these runners will appear in an early issue of *Engineering News-Record*.—EDITOR.]

To October 1, 1919, a total of 5,258,000 cu.yd. had been excavated by hydraulic dredges at a unit cost of 23.6c. This does not include the dredging required to make Bayou Bienvenu available as an outlet for the ships built by the Foundation Co.

At Florida Walk, the site of the siphon and one of the bascule bridges, the first operation was cutting off the drainage canal by constructing cofferdams of earth-fill held between two braced walls of 10-in. sheet piling. The excavation was made from El. 21 the natural ground, to about El. 0, in the open, by dragline excavator and cranes. A cofferdam of interlocking wood sheet piling 50 ft. wide and 230 ft. long was driven and excavation made by using a clam-shell bucket. Cross bracing was placed as excavation went down. A number of movements of earth laterally some of them due to underlying quicksand were arrested, but no material interference to progress resulted. Foundation piles were driven before excavating the cofferdam to El.-22, one foot above the top of a hard layer of red sand at El.-23.0 found floating upon underlying quicksand.

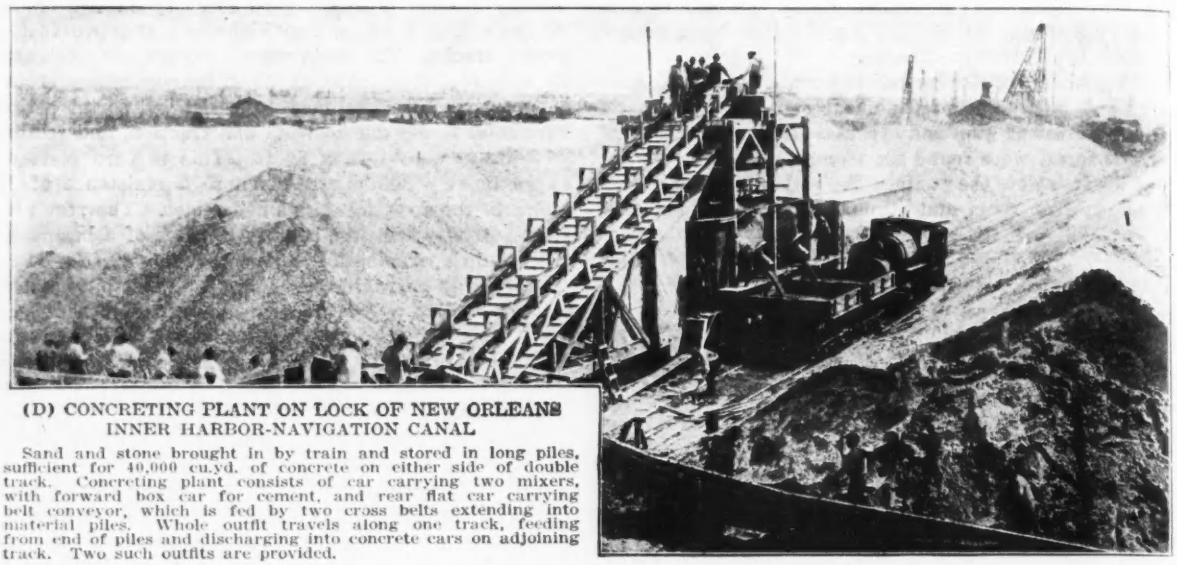
Of the four bridges crossing the canal, one is on the extreme south end of the lock walls. The superstructures and foundations of the other three bridges were originally designed identical, although minor variations were made later, especially in the foundation piers. The superstructures are steel trusses of the Strauss bascule type, designed to carry on two tracks Cooper's E-60 loading, two highways, and two future trolley tracks. The main pier, as originally designed, on the west side, consists of a four-beam and four-column structure designed to resist by portal action horizontal forces due to wind and traction, and resting on a base-slab, 54 ft. x 66 ft. This in turn rests on approximately 350 piles, driven to a resistance of 16 blows to the foot, by a steam hammer. The rest pier on the east side in like manner consists of a beam and two columns carrying loads down to a slab 30 ft. x 54 ft. supported by approximately 170 piles. Test piles took a load of 32 tons without settlement. A design safe load of 18 tons per pile was used for cases involving considerable eccentricity, the average being about 10 tons.

At two of the bridges wood sheetpile cofferdams were driven at about 10 ft. distance from the edge of the slab, and excavation carried down to about El. + 10. At Florida Walk the siphon excavation was widened past the bridge, at about El. + 4. Then in all cases inner caissons were driven, consisting of tongue-and-groove solid 10-in. wood sheetpiling 48 ft. long, at the edges of the base slabs. Top bracing was placed, leaving openings about 6 ft. square, through which excavation was made by means of a bucket. At Florida Walk it then proved practicable to clean up the bottom by hand labor, cut off pile tops, and lay the base slab, after which the remainder of the job was straightforward. At both other bridges the upward pressure from lower strata of water-bearing sand caused trouble, in one case lifting a 14-ft. blanket of clay; consequently, it was necessary to allow water to fill the inner caissons, excavate deeper, and lay under water a much thicker unreinforced slab varying from 8 to 14 ft. Then the inner caissons were successfully unwatered and the remainder of the structure built according to design.



LOOKING INTO THE HEAD WALL OF THE FLORIDA WALK SIPHON

At the site of the lock the first operation was driving an outer line of sheetpiling 48 ft. long to enclose a space 1,600 ft. long by 650 ft. wide. This enclosure serves to cut off a stratum of quicksand about 3 ft. thick at Elev. 0 to—5. Then two hydraulic dredges cut their way through an opening left for the purpose at the north end of the enclosure. In two months, from December, 1918, to February, 1919, these dredges excavated an area 47 ft. deep over an area 1,100 ft. long



(D) CONCRETING PLANT ON LOCK OF NEW ORLEANS INNER HARBOR-NAVIGATION CANAL

Sand and stone brought in by train and stored in long piles, sufficient for 40,000 cu.yd. of concrete on either side of double track. Concreting plant consists of car carrying two mixers, with forward box car for cement, and rear flat car carrying belt conveyor, which is fed by two cross belts extending into material piles. Whole outfit travels along one track, feeding from end of piles and discharging into concrete cars on adjoining track. Two such outfits are provided.

by 120 ft. wide, at bottom, with sides sloping at approximately 1 in 4. Across the north gap a cofferdam consisting of two lines of sheetpiling braced and earth-filled was built. A pumping system was installed and the water lowered to about El. + 4. Piledrivers were brought in to drive a second line of 54 ft. sheetpiling, enclosing a space 280 ft. wide by 1,200 ft. long and intended to complete the cutoff of the layer of quicksand at El. and to cut off a 20-ft. layer of quicksand between —22 and —42. The lateral pressure, proving higher than was anticipated, caused movements in this second line of sheetpiling when the water in the lock excavation was lowered to El. — 3.5. A third line of sheetpiling, of 12 in. 38 lb. Lackawanna steel section, was driven 170 ft. wide by 1,037 ft. long. Of the piles under the structure those needed for construction trestles were driven and left high. Using these piles for working supports, lines of timber bracing about 15 ft. apart were placed from one line of steel sheetpiling across the lock to the other.

At this point pumping operations were resumed. The water had been maintained all these months at about El. 0. Starting in November, 1919, and pumping at full capacity a few hours each day, the water was lowered about 9 in. a day until it was at El. — 8.8. The daily cessation of pumping was intended to give time for all possible gradual adjustments, so as to avoid if possible any sudden movement filling large voids left by water. At El. — 8.8 the pumping was stopped for some time. Lower lines of bracing rangers were placed and cross braced so as to form trusses across the lock. Thus it is hoped that absolutely all lateral movement of sheet piling will be prevented. Then pumping was resumed and the bottom was bared the first week of January, 1920.

It was early realized that perhaps the most serious danger in unwatering the lock would be due to the upward pressure of water in the lower strata of quicksand. Accordingly a number of 10-in. pipes were driven outside of the steel caissons, to tap the quicksand layer between El. — 23 and El. — 42. These are attached to a pumping system which maintains the water in them at El. — 18. Another line of 10-in. pipes was driven within the caissons to El. — 60, tapping a third layer of water-bearing sand. These pipes are bored so that water in them is maintained at lock cofferdam water level. A fourth line, consisting of five pipes 10-in. in diameter, was driven to El. — 60 in the lock caisson to serve as indicators. Measurements show that the water in these indicator-pipes has been very little higher than the water in the lock caisson, the average difference being about 3 ft. and the greatest differences having occurred when piledrivers were at work near the indicator pipes. As these pipes are nowhere closer than 78 ft. to the open pipes, this is thought very encouraging.

For convenience of construction the base slab is to be divided into 69 monoliths, of which a typical one will be 9 feet deep, 15 ft. wide, and 117 ft. long and contain 600 cu.ft. Three construction trestles were built from each end of the excavation north and south toward the center. Forms and reinforcement were successfully placed in the first monolith, and the concrete was put in place March 9, 1920.

This work is being done by force account by the Board of Commissioners of the Port of New Orleans, of which W. O. Hudson is President, Arsene Perrilliat, Chief Engineer, and James Cosgrove, Superintendent of Construction. The consulting engineers are Geo. W. Goethals, Inc. represented in New Orleans by Col. Geo. R. Goethals.

Tie Renewal Record for Nineteen Years

Renewals of ties on the Delaware, Lackawanna & Western R. R. have never been more than 10.2 per cent of the total ties in track for any one year since 1900. In a table giving the record in a committee report presented at the recent meeting of the American Wood Preservers Association there are four years when the percentage was 10 per cent or slightly more. Considerably more than half of the renewals since 1910 have been made with treated ties, until at the end of 1918 there were 3,348,765 treated ties, out of the total 10,524,129 ties, inserted for renewals since 1900 in 2,671 mi. of main and side tracks. The percentages of ties inserted the last four years ending 1919 are 7.1, 5.7, 4.4 and 5.4 per cent respectively.

Proportioning Concrete From Study of the Aggregate

Comment on paper "Mixing Concrete by Surface-Areas on Actual Work," by R. B. Young, in "Engineering News-Record," Jan. 1, 1920, and reply by Mr. Young to one of the criticisms.

Proportioning Method of Narrow Application

By G. M. WILLIAMS
U. S. Bureau of Standards, Washington, D. C.

THE assumption made at the beginning of Mr. Young's article for the selection of the "economical" mixture seems to the writer to be erroneous, and the methods employed lead to results similar in practical application to those which may now be obtained by the common method of volumetric proportioning. The terms "surface area" and "water-cement ratio" as used are merely new terms for expressing the same qualities which are now determined in the volumetric method of proportioning.

Both of the proponents of new methods of proportioning included in their theories water formulas, which it was claimed would result in equal consistencies and equal strengths for all workable mixtures. General laws were stated by which strength could be predicted for all normal concretes. The method employed by Mr. Young narrows the conclusion down to the possible value of any particular predetermined grading of an aggregate because of the limitation which he places on surface areas.

The first and greatest limitation which Mr. Young employs, and which removes his method from any possibility of being of general application to wide ranges of combinations, as was claimed for the methods proposed by Professor Abrams and Mr. Edwards, is the determination at the outset, without the employment of strength tests, of the "most economical aggregate grading," which he states to be "the one containing the lowest surface areas per cubic foot of material which can be successfully handled and placed." Whereas the surface area theory proposed by Mr. Edwards would admit of the use of wide variation in gradation (large differences in surface areas), Mr. Young at the beginning limits his aggregates to the "lowest areas which can be worked." Such a result is, of course, obtained by keeping the fine material in the sand or fine aggregate to a minimum. In usual concrete mixes, where the ratios of fine to coarse are as 1 to 2 (such as 1:2:4, 1:3:6, etc.) the area of the sand is usually more than 90 per cent of the total area of both coarse and fine. Therefore, to obtain low areas it is necessary that the grading of the sand, the material whose variation most greatly influences workability and segregation, be made as coarse as possible and still permit of a workable mix.

Furthermore, the use of high area aggregates requires larger quantities of cement, which, if the same flowabilities are obtained, result in high strengths which are unnecessary and uneconomical. It is clear that this limitation to low area aggregates is essential for economy, and as a result the method employed is narrow and limited rather than broad and general as is that proposed by Mr. Edwards.

Tests made along his line with which the writer is familiar do not bear out the basic assumption that low surface areas are most economical. It is found that the limitation of aggregates to low total areas results in "harsh" mixes which are difficult to work and whose strengths are lower than mixtures having higher surface areas. It is also found that the quantity of cement required per cubic yard of wet concrete is greater for such harsh, low area mixtures than for the high area mixtures.

The resulting concretes, which Mr. Young's method provides, in reality result in false economy, since the concretes are more difficult to place, have lower compressive strengths and require a slightly greater quantity of cement. In other words, the use of low surface area aggregates is generally opposed to economy and strength.

The concretes shown in Table I were made with sands of varying degrees of fineness combined with the same gradation of coarse aggregate, all from the same source of supply.

TABLE I. PROPORTIONS 1:2:3 BY VOLUME. AGE 28 DAYS. EQUAL FLOWABILITIES FOR ALL.

Aggregate Number	Surface Area Sq.In. per 100 G. Agg.	Surface Area per Gram Cement	Pounds Cement for 1 Cu.Yd. Concrete	Compressive Strength
1	103	5.0	603	1,873
2	114	5.6	600	2,456
3	167	8.2	600	2,348
4	233	11.6	600	2,508
5	268	13.3	601	2,427
6	315	15.4	597	2,850
7	393	19.2	594	2,865

These concretes are fully comparable since equal consistencies or flowabilities were obtained as measured on the "flow table." Concretes 1 and 2 were so harsh that they would be ruled out as unworkable but No. 3 was a somewhat harsh, but workable concrete. The base of working or plasticity increased with the amount of fine material in the sand and it is seen that strengths were not reduced. The tendency to segregate when very fluid was less marked as the amount of fine material in sand or the surface area increased. It is also found, with flowabilities equal, that the cement paste in a high area mix contains a smaller proportion of water than in one having a low area. This condition no doubt partly accounts for the higher strengths of the mixes containing the higher quantities of fine aggregate. In such mixes, although the calculated w/c relation may be equal or nearly so for two mixtures, the paste of the low area mix will be the wetter, so that the true w/c relations may be quite different. Further, as the flowabilities of the two are equally increased, the low area aggregate concrete will be the first to segregate, and become difficult to handle.

For apparent economy the modified surface area theory as employed by Mr. Young necessitates the selection of such an aggregate as numbers 3 or 4 above. The resulting concrete requires slightly more cement per cubic yard, has a lower compressive strength, and is more difficult to place. Such a condition results since the basis of the modified method is the erroneous assumption that the most economical mixture is one having the lowest total surface area, and which Mr. Young states is near the border line of workability.

It is apparent that the making of strength tests does not enter into the procedure of this modified theory until after the "economical" mixture of aggregate is selected. After surface area is determined various ratios of cement to areas per 100 square feet of aggregate are selected, concretes are then made up of equal consistencies as determined by eye and compressive strength for each mix determined. The strength values with calculated factors for areas and water-cement ratios are then plotted and the limiting factors for various classes of concretes determined from the resulting curves.

That this method differs little from methods at present in use, except that the measured and calculated factors are given different names, is apparent. In practice we have found that Potomac River materials, in the proportion of 1 part sand to 2 parts aggregate is about the limit of coarseness which it is desirable to use. Less fine sand in the fine aggregate or a smaller ratio of sand to coarse aggregate, results in harsh concretes, difficult to properly place, while with the same flowability, a finer sand or more sand increases workability and results in less segregation in the wetter mixes. The above 1:2 combination is probably quite similar to that which Mr. Young would select as his "economical grading" if using our materials. In accordance with Mr. Young's next step in the process we will make up concretes having the same consistencies of flowabilities with the following proportions of cement to aggregate: 1:1½:3, 1:2:4, 1:2½:5, 1:3:6, and 1:4:8.

Recent determinations indicate Potomac River materials to have the approximate areas of 1,830 sq.ft. per 100 lb. and 86 sq.ft. per 100 lb. respectively for the sand and gravel.

The data in Table II will then result:

TABLE II.

Proportions	1:1½:3	1:2:4	1:2½:5	1:2½:6	1:4:8
Cement pounds, per 100 sq.ft.	3.3	2.5	2.0	1.65	1.25
Per cent water by weight of cement or w/c	Increases as quantity of cement decreases				
Strength	Decreases as quantity of cement decreases				

It is seen from this table that a table similar to that presented by Mr. Young in his Table II will result. Although we may not be accustomed to calculating and viewing our mix from the viewpoint of surface area and the cement-surface area relation, the relation is there and maybe obtained by computation. Although we may not be accustomed to calculating or expressing water in terms of quantity of cement the relation is also there. Percentage of water by weight of cement is calculated as easily as water-cement ratio, but it is seen that both are incidental and a resultant, for any given flowability, of the predetermined grading and mix. Our results may be plotted in the same manner as Mr. Young's Figs. 3 and 4 and we may likewise draw up a table similar to his Table III. In the field, quantity of cement and mixing water may be varied as described by Mr. Young, and the resulting concretes strengths may be checked up in the same manner by molding samples of field concrete.

However, with our present knowledge of the advantage to be gained by using more fine aggregate (greater surface area) in our mix, we would not confine ourselves to such a low area combination as is required by the economical considerations of Mr. Young's modified method. Very likely we would reduce the above number of mixes and add a similar series in which the sand-gravel ratio would be 2½ to 3½ or even larger or add more fines to the sand and maintain the same relative porportions. Past tests show that the 2½ to 3½ or 2½ to 4 ratio mixes will have greater workability for the same flowability, higher strengths, and require less cement per cubic yard of concrete. While the surface area method limits the investigator to low areas aggregates, the old volumetric trial method obtains identical results and permits the use of wide variation in gradations which are generally found to result in more satisfactory concretes.

Proportioning Method Works Well in Practice

By R. B. YOUNG

Hydro-Electric Power Commission of Ontario, Toronto, Ont.

Mr. Williams' criticisms are interesting, but he fails to develop any practical objections to the use of the method described. His sweeping statement that the method cannot possibly be of general application to wide ranges of combinations is not borne out by actual experience, unless it happens that by "wide ranges of combination" he includes impracticable mixtures such as would never be used in actual work. No claim has been made that a method has been developed that will function under these conditions, and the fact that the method will not do so does not detract from its practical value. It has already been used with a wide range of combinations such as are met with in commercial work with satisfactory results.

Whether the "most economical grading" of the aggregate, as defined in the article under discussion, is or is not the most economical or whether it is or is not obtained in the field is not vital to the success of the method in controlling the quality and mobility of the concrete. It is important that by its use it is possible to obtain concretes of the strength and consistency desired, to confine the variations in both strength and consistency within narrow limits and to do this regardless of the varying character of the materials. This feature—continuous control—is considered very important.

Mr. Williams dwells at some length on the cement requirements of different gradings and speaks of economy of concretes as if the quantity of cement used alone determined this. In actual work cement is only one factor entering into the cost of the finished concrete. It is often more profitable to use an inferior material which is close at hand than to import a better aggregate which would require less cement. It is at times cheaper to use additional cement rather than to carry out the screening and handling necessary to produce an aggregate more economical in this material. The most economical grading is usually, therefore, a matter of academic interest.

In considering Mr. Williams' comments on the theoretical basis of the methods described, it is necessary to bear in mind that he and his associates deny the validity of the data originally presented by both Professor Abrams and Mr. Edwards upon which the theories underlying the method were derived, and that his counter arguments are based upon as equally unsubstantiated data of his own. It is therefore not surprising that he arrives at totally different conclusions than do those who accept the data of these gentlemen.

It is true, as Mr. Williams points out, that data from such tests as he describes can be used to obtain a table similar to our Table III. It is also true that data in the form which Mr. Williams obtains it cannot be used to

more than estimate the proportions necessary in any given case and even where one of the proportions actually tested are used, it in no way guarantees field concrete of similar quality unless the consistency and grading of the aggregate is the same in both cases. Moderate variations in the gradation or moisture content of the aggregates cannot easily be compensated for. By putting these results in the form we do we compensate for these variations and eliminate guess work, and therefore this method of using the data has decided advantages over the others.

It may be true as Mr. Williams intimates that Fig. 4 is "representative of the variation in strength with increase in mixing water and change in cement content for this one graded aggregate," but it is also true that the grading of the fine aggregate and the relation of fine to coarse aggregate can be varied within a considerable range, and the curves obtained with such combination so closely agree with one another that any one of these curves can be said to represent all. This has been brought out by our laboratory tests and substantiated by our field experience. Thus these objections are not of any consequence.

Our method of proportioning was developed with both the scientific and practical aspects of the problem in mind. No doubt it includes features not acceptable to the highly scientific and theoretical members of the concrete fraternity. It is, however, helping us to produce better and cheaper concrete and it is results that count.

Proportioning the Concrete for Government Ships

By H. A. DAVIS

Formerly Inspecting Engineer, Concrete Ship Section, E. F. C., San Diego, Cal.

It may be of interest to cutline briefly the method used by the writer in controlling the quality of the concrete used in concrete ships of the Emergency Fleet Corporation.

The character of the concrete work called for in concrete ships demanded a high strength requirement, great flowability and the maximum size of aggregate was limited to ½ in. In order that the concrete used be as uniform as possible the aggregate, generally crushed shale slag, was separated into sand (below ¼ in.) and coarse aggregate (¼ to ½ in. or ⅜ in.).

Then preliminary laboratory tests of each aggregate intended for use in these ships were made according to the following plan:

The first series comprised a study in which the cement content was the variable, a fine to coarse aggregate ratio being assumed that insured a concrete containing sufficient mortar, and a consistency measured by the slump apparatus that a knowledge of possible field requirements indicated would be suitable.

In the second series the effect of varying the water content was studied. The cement content was selected from the first series results in light of the strength requirement and the same fine to coarse aggregate ratio maintained. The relation between amount of water in concrete and amount of "drop" measured by the slump apparatus was established for future use in field.

A third series was made in which the effect of small variations in the ratio of fine to coarse aggregate was studied the same cement content as in series two being maintained and a constant consistency as in series one being controlled by "drop" or slump test.

In the field the concrete was proportioned in the light of the preliminary laboratory data to meet the constructor's desires as to workability of concrete as far as possible without sacrificing the strength requirement and with due regard to the amount of fine and coarse material as received on the work from the economic viewpoint. It was necessary at times to use small amounts of extraneous materials to achieve these results but when such was necessary its advisability or effect on the resulting concrete was determined by actual tests. The consistency was controlled in the field so that as uniform as possible a concrete could be used throughout, by the slump test using the apparatus devised by the writer and described in *Engineering News-Record*, March 27, 1919. Frequent tests were made in field to determine the grading and weight of aggregate as furnished.

The writer has found this appartus useful not only in maintaining a uniform consistency in the field but as an indicator in the laboratory of the workability of the concrete. A concrete mixture that irrespective of the amount of drop indicated by this apparatus that always produces a symmetrical cone never gave any difficulty as to workability in the field. In fixing the amount of drop permissible careful consideration must be given to the character of work.

Applying the writer's method to any concrete work, it may be said to comprise direct and sufficiently comprehensive studies of the three variables (cement content, water content and gradation of aggregate) the importance of which is recognized by practically all experimenters and proportioning in the field in a way to maintain in the concrete the qualities desired both for the work and by the construction as far as possible in a manner to interfere as little as possible with the constructor's work and so that a uniform concrete be used throughout handling of which workers become familiar with and more efficient as work progresses.

This last factor is essential, as field changes in the concrete mixture made during progress of work frequently result in confusion and difficulties and are a source of irritation to the construction.

Any discussion of the theoretical basis for such studies has been purposely avoided by the writer, for it is believed that too much emphasis has been laid on this phase of the subject to the confusion of the actual users of concrete. The theoretical basis used by the experimenter in outlining necessary direct tests is not as important as the recognition by the experimenter of the requirements due to the character of the work, and difficulties and variations in the important factors that may be encountered in the field.

An experimenter of sufficient experience acquainted with the aforementioned requirements and difficulties should be able to outline a series of preliminary laboratory tests sufficiently comprehensive to cover these points and be able to apply this information in the field in a manner to give proper consideration to the requirements of the work, the difficulties of the construction and other economic phases. The writer recognizes the value of such indirect tests as mechanical analyses of aggregate, volumetric tests of concrete to determine yield and density, etc., as means of cataloging experience for future use and for reducing to a reasonable minimum the necessary direct tests to be made in the solution of such concrete problems.

Wood Block Pavement Fails Through Contraction and Flotation

Loosely Laid Blocks Shrunk by Sun and Floated by Melted Pitch—Precautions in Construction Remedy Trouble

By W. W. Horner
Chief Engineer, Sewers and Paving, St. Louis, Mo.

EXPANSION has been believed to be the greatest destructive agency in new wood block pavement. It appears, however, that a certain amount of expansion is not only desirable, but essential. Contraction under certain conditions may be a greater danger than expansion. Evidence that this is a fact is furnished by experience in constructing certain sections of wood block pavement in St. Louis, Mo., in the season of 1919. One section of pavement was destroyed and another section suffered damage because of contraction of the blocks and their flotation due to melted pitch.

The St. Louis pavement, designated Contract *A*, and one block in length, is on an east-and-west street having double car tracks on a 40-ft. roadway. The concrete base was finished with a 40-lb. concrete roller and a belt, the resulting surface being very satisfactory. After setting it was mopped with pitch at 140 to 145 deg. melting point, and the blocks were laid generally after the pitch had cooled. The blocks were not laid tight. They were lug blocks, having $\frac{1}{16}$-in. projections, and were laid in contact without ramming. A light rain occurred during the paving, and the bottom of the blocks were thoroughly wetted, but no appreciable expansion took place and the water was drained out, the paving and rolling completed, and the pitch filler placed. The schedule of work is given by Table I.

The first outstanding feature of this work was the entire absence of bleeding. The second and most surprising feature was the remarkable contraction which took place in the block after laying. Throughout all of this work there was little excessively hot weather, but the air was very clear and the temperature of the pavement in the sun undoubtedly reached a high mark. All the blocks showed a notable shrinkage in the pile when exposed to the bright sun. The blocks continued to shrink on the street, and apparently the filling of the joints with pitch had very little effect on the rate of shrinkage. The looseness of the blocks was aggravated by the rather loose laying in the beginning, but the results would have been the same in any case as joints originally $\frac{1}{16}$-in. wide opened to $\frac{3}{8}$ in. and even to $\frac{1}{2}$ in. After the blocks had reached this condition of contraction, the third unfortunate factor came into play. This was the combination of the block shrunk out of contact with its neighbors; the very hot sun bringing the pavement to a temperature greater than the melting point of the pitch; the resulting liquefaction of the pitch, and the floating of the blocks as individual pieces of wood in the pitch pools. The illustration shows this condition; in some instances the blocks are an inch above the pavement.

TABLE I. SCHEDULE OF OPERATIONS IN CONSTRUCTING PAVEMENT A

Day	Temp. Max.	Average Daily Max.	Average Daily Mean	Remarks
May 10–25	75	66	59	May 10 and 12, blocks shipped. May 26, began paving. May 31, completed paving.
May 26–31	88	82	75	
June 1–10	88	82	73	Joints badly opened. Pitch settled.
June 11–18	91	90	80	Pavement somewhat rough. June
June 19–26	92	89	77	29, rerolled blocks and refilled joints
June 27–30	90	83	74	with pitch.
July 1–15	96	90	81	Work noticeably rough. Pitch again
July 16–31	99	92	82	settled in joints.
Aug. 1–9	102	91	81	Aug. 9, surface in extremely bad condi-
Aug. 10–20	95	88	78	tion. Decided to remove and repave
Aug. 21–31	90	83	75	entire block.
Sept. 20	..	..	..	Removal of block started.

Contract *B* was also a one block street in an east-and-west direction, but differed from *A* in having a narrow roadway without car tracks, and in being almost completely shaded by high buildings. It is also bordered by loading platforms for wholesale mercantile houses, and carries intense traffic, largely steel-tired drays. With respect to traffic and to sun conditions, the situation was almost the exact opposite of that on Contract *A*. In other respects the work on the two contracts was almost identical (slight difference in preliminary steaming and in the oils) and the conclusion may be drawn that the failure of the blocks on *B* to contract was due to the shady condition and to the ironing effect of traffic. In appearance the blocks were very similar to those used on *A* and like all of the blocks furnished failed entirely to show any signs of bleeding. No defects appeared and the pavement continued to improve in smoothness. The work on the whole was highly satisfactory.

Contract *C* was a north-and-south street having a

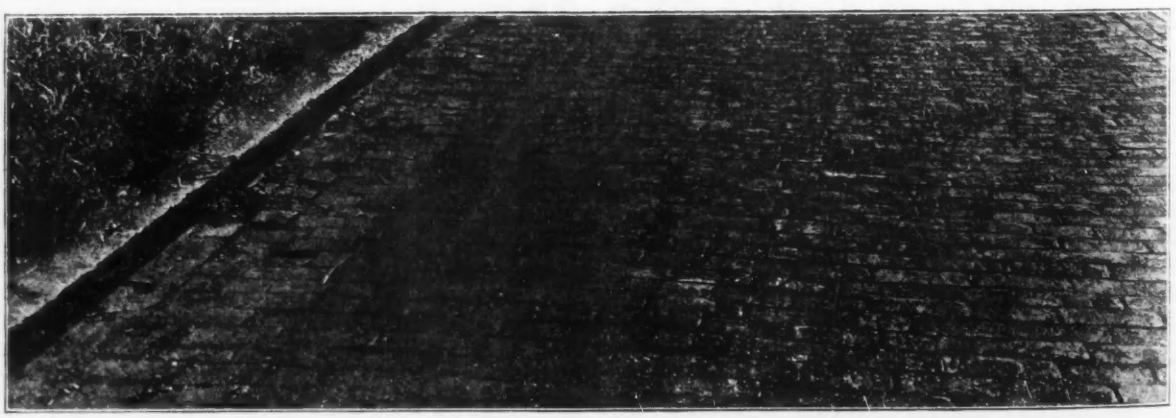


FIG. 1. WOOD BLOCK PAVING, CONTRACT "A," SEVEN WEEKS OLD, SHOWING SHRINKAGE, AND FLOTATION IN THE PITCH FILLER

50-ft. roadway and double car tracks. There is comparatively little shade and the traffic while considerable, is largely pleasure cars. The manufacturer who supplied the blocks for Contract *A* also furnished the blocks for this contract. These were also lug block, had the same dry appearance, and also failed to show apppreciable signs of bleeding. They were laid slightly tighter than those on Contract *A*, but were not driven up tight. Except for a very few feet at one end, a large part of these blocks lay several days before the joints were filled with pitch, and during this time the shrinkage was very rapid. There was also a very definite tendency for the longer blocks to warp or curl upward, and when the pitch was applied these blocks in particular were inclined to float. This was undoubtedly due to the hot pitch from the joints running under the upturned ends of the blocks and combining with the paint coat pitch in place. All of this pitch had a melting point of from 140 deg. to 145 deg. F.

Efficacy of Sand Coating

In these two city blocks of paving probably 200 blocks floated somewhat in the pitch. This occurred during the actual pitching, or within a few hours thereafter, and the fact that the trouble did not become worse, was probably due to the heavy coating of sand which was put over the pavement, and which was thoroughly wetted four or six times a day throughout the rest of the summer. It is interesting to note in this connection that even though this wet blanket of sand lay on the blocks almost continuously during one week of moderate weather, there was only one instance in which any signs of expansive pressure appeared, and this did not indicate any material amount of expansion.

About the time that the first two blocks on Contract *C* were paved a definite deterioration of the Contract *A* pavement became evident, and it was decided to take all possible precautions on the remainder of *C* to prevent the occurrence of a similar situation. At the request of the writer the block manufacturer also decreased somewhat the preliminary steaming treatment on the *C* block after the first car loads had been shipped and this may have had some effect in reducing the contraction.

To prevent the floating of the blocks in the hot pitch two changes were made in the methods of construction. First, the blocks were driven together with a heavy sledge as tightly as possible. The result was that even where considerable shrinkage took place, the blocks were not usually relieved from contact with each other, and the floating of individual blocks was to an extent prevented. The second change was to raise the melting point of the pitch filler, at first to 150 deg. F., and after about two blocks more had been laid, to 160 deg. F., at which point it was kept.

As there was still some evidence of the curling of the blocks on the hotter days, an additional preventive was used against flotation. This consisted of casting over the pavement and sweeping into the joints a sufficient amount of limestone dust, or fine sand, to fill the bottom of the joints about ¼ in. By this means the pitch in the joints was kept away from the pitch in the base, and the tendency of the hot joint pitch to flow under the warped block was reduced.

The writer felt also that the trouble was somewhat aggravated by the original separation of the blocks produced by the lugs, and it was decided that the east half of the street would be constructed of rectangular blocks. No actual demonstration of the advantages of this change was possible as the paving of the east side was done under more moderate temperature conditions, and shrinkage of the blocks was much less apparent. It does not appear, however, that the use of lug blocks is of any advantage under conditions where the blocks tend to shrink apart.

How many of the above precautions were really necessary cannot be now determined, but it has been demonstrated that non-bleeding and highly shrinking blocks can be satisfactorily laid even during long dry summers in this climate, if they are driven tightly together, if a fine mineral filler is used in the bottom of the joints, if a somewhat high melting point pitch is used, and if the preliminary steaming is not too great, and finally, if the pavement after laying is protected from the direct sun heat with a moderate amount of wet sand.

The laboratory record of the oil, and the log of the treatment of blocks of the three contracts showed that there was little difference in the oils used, except as to the lighter oil used on *C* and in one charge on *A*; that the treatment did not vary greatly, and that the variations which existed might divide the blocks into two classes with respect to the preliminary steaming. The Contract *A* blocks and the first ten cars of *C* blocks were steamed for about four hours at a temperature of from 245 deg. F. to 252 deg. F., while the *B* blocks and the remainder of the *C* blocks were steamed at from 230 deg. F. to 235 deg. F., and generally for not over 3½ hr. It appeared that these two different classes of blocks actually behaved differently in the street in respect to the amount of shrinkage, but from the data in hand we are not justified in charging the excessive shrinkage of the one class of blocks to the higher temperature of the preliminary steaming.

Laboratory Tests of Wood Blocks

Unfortunately no laboratory tests for absorption and shrinkage were made on either Contract *A* or Contract *B* blocks immediately after delivery. No tests were made on the *B* blocks at any time, but a sample of left-over block from Contract *A* was secured, and a study made after these blocks had been taken away from the street, and stored in the contractor's yard for nine weeks. These blocks must have seasoned considerably during the storage period. In spite of this, however, they show the following remarkable results:

Five blocks immersed in water at 77 deg. F. for 45½ hr. showed an average increase in weight of about 5½ per cent and an average linear expansion of 0.25 per cent. These same blocks seasoned in an oven at 158 deg. F. for 43½ hr. showed an average loss of weight of 7.6 per cent and an average linear contraction of 1.75 per cent from their original dimensions as received. A second series, in which the tests were reversed, that is the block was first seasoned and later immersed, showed an average loss in seasoning at 158 deg. F. in 42½ hr. of 8.6 per cent by weight, and an average linear contraction of 2.1 per cent. After immersing for 43½ hr. at 77 deg. F., a net gain in weight averaged only 1.6 per cent, and two of the blocks actually showed a net loss. None of the blocks came back to their original size, and the average linear contraction after immersion

was still 0.6 per cent as compared to 2.1 per cent after direct seasoning. In other words, even after this long storage period it was practically impossible to make this block expand, and the contraction values reached a seriously high percentage.

Blocks from Contract *C*, treated on Aug. 30 by the somewhat lighter preliminary steaming system, showed an average linear expansion after seasoning at 158 deg. F. for 48 hr. of 2.2 per cent or very nearly the same as the stored *A* block mentioned above, and an average linear contraction of 1.2 per cent. Untreated block taken from the same stick of timber showed an average linear expansion of 0.5 per cent.

Various other tests have been made from time to time, not as part of the completely predetermined investigation, but more to bring out the characteristics of the blocks which were being handled. These tests have been tabulated in Tables II and III.

TABLE II. TESTS FOR EXPANSION AND CONTRACTION

Immersed in Water				Seasoned at 158°			
Condition	Hours	P. C. Gain Net, from Original	P. C. Lin. Exp., from Original	Condition	Hours	P. C. Loss Net, from Original	P. C. Lin. Contracting from Original
Contract A Block After 9 Weeks Storage							
As received	48	+ 5.40	+0.25	After immersion	48	7.70	2.00
After 48 hr. seasoning at 158° F.	48	+ 1.50	—0.19	As received	48	8.90	2.10
Average	48	3.45	+0.03	Average	48	8.30	2.05
Contract B Block from East Side of Street							
As received	22	+ 3.43	+0.21	After immersion	16	3.55	3.44
As received	116	+11.28	+0.35	After immersion	116	13.50	3.31
As received	22	3.93	+0.28	As received	22	4.76	0.82
As received	116	8.19	+0.61	As received	116	10.29	2.58
				As received	22	3.72	0.62
After seasoning	22	3.77	+0.37	As received	116	12.54	2.98
After seasoning	116	7.53	+0.39				
Average	116	9.00	+0.45	Average	116	12.11	2.96
Contract C, Block from Treating Plant							
After seasoning	48	1.0	—1.2	As received	48	8.8	2.2
Contract C Block, Untreated Block							
				As received	48 (at 160 d. F.)	12.0	1.6
After seasoning	96	14.0	—0.5		Ditto	13.0	1.5

The figures of Table II demonstrate clearly that these blocks after treatment were in the condition which wood preservers have always considered ideal, that is, expanded the maximum possible amount, and this result is well checked by the failure of the blocks on the street to expand when covered with wet sand. The whole experience shows clearly the absurdity of sprinkling these blocks before paving, as is advocated in some of the standard specifications. The blocks which are seasoned in two days at sun temperature to such an extent that they still remain contracted after soaking in water for two days, will hardly be materially affected by light sprinkling.

The measurements in Table III were taken with the idea of determining the effect on the block of exposure during shipment. These tests were made from five sticks of timber from each of which three adjacent blocks were sawed. The first group was tested immediately after treatment; the second group after delivery on the work, and the third group was not treated, but was tested the same time as the first.

Inspection of Table III rather leads to the conclusion that the action of the blocks in the street was not due to any positive effect of the treatment, and that the result would have been very similar if the timber had been handled untreated. In all cases it appears that the fiber of the treated block was about at the moisture saturation point, that the addition of the water simply filled the cells, without being able to cause expansion, while the abstraction of water was directly from the fiber, and contraction necessarily followed.

TABLE III. CHANGE DURING TREATMENT AND TESTS

	P. C. Weight	P. C. Lin. Exp.	
Average gain in treatment, Group 1	+44	+0.32	A
Average gain in treatment, Group 2	+39	+0.08	B
Net loss in shipment	5	—0.24	B
After seasoning 48 hr. at 160° F, Group 1	+31	—1.10	C
Net loss in seasoning at 160° F	13	—1.52	C
After immersion 96 hr. at 77° F, Group 1	+45	—0.38	D
Net change after seasoning and immersion	+ 1	—0.70	D
After seasoning 48 hr. at 200° F, Group 2	+20	—3.26	E
Net loss in seasoning at 200° F	19	—3.34	E
Untreated block, Group 3, after seasoning 48 hr. at 160° F	—12.0	—1.88	F
Untreated block, Group 3, after seasoning 48 hr. at 160° F. and 96 hr. at 200° F	—23.0	—5.8	G

These tests have indicated a possibility of arranging the laboratory control of street work based directly on the moisture content of the block as shown by the tests. The 48-hr. tests for seasoning at 158 deg. F. and for immersion at 77 deg. F. can always be carried out before blocks arrive on the street, and the characteristics of the blocks determined from these tests will indicate whether precautions against contraction or against expansion are necessary.

Another interesting result of the examination of this wood pavement was the remarkable reduction in melting point of the pitch. In one instance the pitch tested at 145 deg. melting point and then cooked considerably before pouring, was found after ten weeks in the pavement to have a melting point of 131 deg. This occurred apparently through contact with the creosoted block and in spite of the fact that there was no appreciable bleeding of the block during this time. In another instance the reduction was from 145 deg. to 111 deg. under similar conditions of non-bleeding block, but the second sample was taken about 1 ft. from the street car rail and the packing under the head of the rail was a mixture of sand with a pitch cut-back, and the cut-back may have become somewhat diffused.

Conclusions

Where economic conditions permit, specifications for block delivered during the summer months, and to be laid under climatic conditions similar to those in St. Louis, should require their manufacture from thoroughly dry timber. It seems probable that this change will give a block which is capable of expansion and consequently of some bleeding, but the writer believes that the modern specification for a smooth concrete and pitch bed, and a bituminous filler, if carefully carried out will permit of absorption into the block at so slow a rate that expansion troubles will never be noticeable. If a small amount of bleeding does appear in the first year, the effect will not be serious compared to the conditions outlined above.

If it is necessary to treat partially green (or partially seasoned) timber for use under these climatic conditions, it would seem advisable to reduce somewhat more the amount of preliminary steaming. It would also seem

advisable to make accelerated expansion and contraction tests and to regulate the details of paving in accordance with the results. If considerable contraction is indicated, it would be advisable to pave the block as tightly as possible, to use a fine mineral dust in the bottom of the joints, and possibly to substitute an asphaltic for a pitch filler during very hot weather. With these precautions there seems no reason why even the partially seasoned block cannot be handled in extreme weather, and why the resulting pavement under the present specifications could not be more nearly the ideal in appearance than even our best work in the past, and there is every reason to believe that the life of the pavement will be very considerably increased.

To Build Large Bridge Across the Connecticut at Springfield

Monumental Structure of Concrete Arches To Be Started After Some Years of Discussion As to Location

By C. M. Spofford

Fay, Spofford & Thorndike, Consulting Engineers, Boston, Mass.

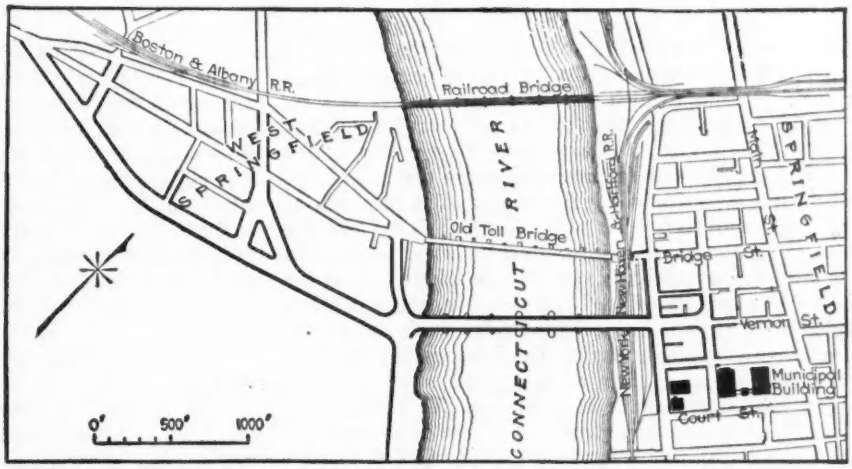
ONE of the largest bridges to be built in this country since the war is to be started at Springfield, Mass., as soon as open weather permits construction operations. This bridge, across the Connecticut River, connects the city of Springfield and the town of West Springfield; it has been under consideration for a number of years and under definite study by a commission for the past three years. The procedure has been somewhat complicated, but difficulties have now been adjusted, bids were opened Mar. 10 and the contract has been awarded.

The inadequacy of the existing bridges here has long been recognized, but a new bridge has been delayed for years by disputes among various factions and by the possibility that the New York, New Haven & Hartford R.R. might adopt certain plans long under discussion for altering or removing its railroad yard which occupies the river front on the Springfield side of the river and which would be crossed by a new bridge. Finally, the situation became so acute that the Massachusetts Legislature was requested to grant authority to construct a bridge across the river and what is more remarkable, to determine its location. This appeal resulted in the Legislature in 1915 pasing an act establishing a Board of Commissioners to be appointed by the Supreme Judicial Court of the County of Hampden to determine the location, make the necessary plans and estimates of cost, and apportion the expense between the county and the various municipalities especially benefited.

This commission after a number of hearings decided to lay out the bridge so as to establish the westerly end near the old toll bridge and the easterly end adjacent to the Court Square in Springfield where has been growing up a group of beautiful municipal buildings. This location gave a skew bridge making an angle of approximately 68° with the river, centering on the large tower of the Springfield municipal group.

Plans were made for such a bridge and were submitted to the Supreme Court in June, 1917. This bridge had a 42-ft. roadway and two 9-ft. sidewalks. Immediately, however, upon publication of the report protests arose against the location and against the narrowness of the roadway. Petitions requesting the recommital of the commissioner's report and revisions which contemplated a bridge 75 ft. wide, located square across the river, just below the Springfield Public Square, was circulated and signed by more than 17,000 inhabitants of Hampden County. The commissioners thereupon withdrew their original report and proceeded to prepare designs which culminated in the design which is at present contemplated.

This new bridge, plans for which were presented to the court in October, 1919, contemplates a new system of approach streets to be built on undeveloped land at West Springfield, to connect the westerly end of the bridge with the built up section of that town and with the main thoroughfare to the west. Practically all the land and filling for these approaches would be furnished without charge by the realty interests who control the vacant land.



LOCATION OF NEW BRIDGE ACROSS CONNECTICUT RIVER AT SPRINGFIELD, MASS.

A perspective of the proposed new bridge is shown on p. 818. It is divided into two portions; (a) the river bridge consisting of seven reinforced-concrete arch spans with a total length of 1,129 ft. between abutments and a clear width of roadway of 60 ft. with sidewalks 10 ft. wide on each side. Each span consists of five two-hinged arch ribs, two spandrel walls, columns and a floor system, all of reinforced concrete. The channel span, which is the third span from the Springfield end, has a clear opening of 176 ft., a rise above the river at low water of 45 ft. with a clearance of 41 ft. for a width of 60 ft. (b) A reinforced-concrete viaduct having a total length of 300 ft., consisting of nine spans, eight of which have a length of 31 ft. in the clear.

The river bridge is necessarily unsymmetrical on account of the location of the channel which is nearer the Springfield side of the river but it was found pos-

sible to repeat two spans on either side of the channel span, hence the five spans forming that portion of the bridge between the two sets of small towers shown in the perspective are symmetrical with respect to the channel span. The other two arch spans are of lesser length than any of the arch spans above mentioned and in a measure, balance the viaduct at the easterly end. The piers flanking the channel span and surmounted by high ornamental towers are necessarily large in order that they may serve as abutments provided the arch construction of the channel span should ever be replaced by a draw span. This contingency seems extremely unlikely but the legislative act authorizing the bridge required that such provision should be made. The remaining piers are dependent for their stability against overturning upon the lateral support furnished by the adjoining arch spans and a carefully planned system of erection of the ribs and floor system in all arch spans is specified by the engineers, in order to insure stability of these piers during construction.

The piers and abutments are to be supported by wood piles driven to a bearing in clay, a stratum of which is shown by borings to lie at a moderate depth below the river bed. The piers themselves are of concrete with granite facing above low water. The exterior shell of the towers and cartouches, the railing on the river bridge and certain other ornamental features are to be constructed of artificial stone.

The steel reinforcement of each of the arch ribs consists of two latticed girders connected by cross latticing and provided with hinges at each end at the center. It is planned to have these ribs shipped in sections; in all spans field splices which may be riveted up before erection, if desired, are provided at or near the quarter points. These steel ribs are to serve as centering for the rib concrete, this feature having two distinct advantages: (a) practically the full compressive strength of the steel reinforcement is utilized, which is not possible with the ordinary rod reinforcement where the stress in the steel depends entirely upon the relation between the moduli of elasticity of steel and concrete, and (b) falsework in the river to support the bridge during construction is necessary only during the brief period required to erect the steel ribs in a given span which requires only a bent at the center of each span. This latter condition is especially important in the case of a river like the Connecticut which is subject to severe and sudden floods and to bad ice conditions.

Each steel rib is to be erected as a three-hinged arch but will ultimately be spliced at the crown, thus transforming it to a two-hinged arch and reducing the center deflection under live-load, which is one of the serious objections to three-hinged arches. The side ribs carrying the spandrel walls are to be spliced at the crown when the rib concrete is poured and the interior ribs are to be spliced after the rib and superstructure concrete is poured, the pouring of the rib concrete at the crown of the arch being postponed in order to permit the splicing of the steel.

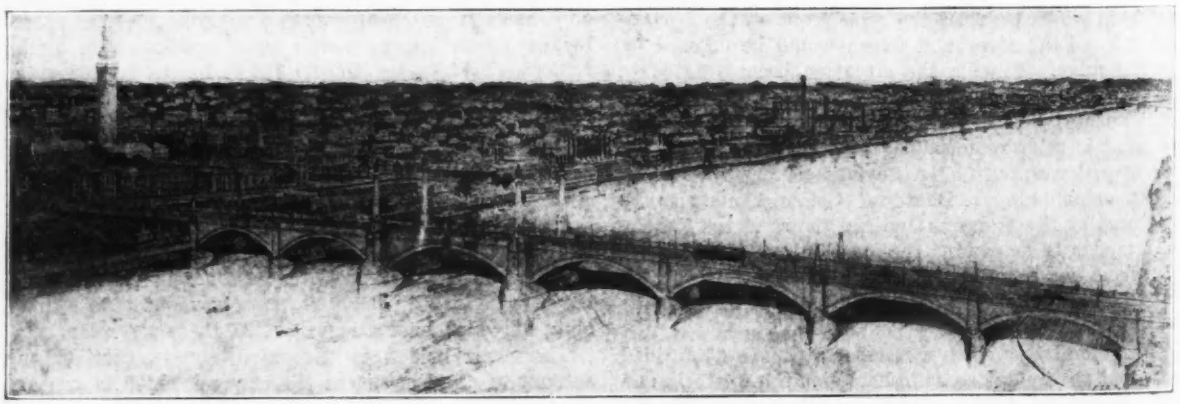
The bridge roadway is to be paved throughout with stone block paving; the sidewalks are to have granolithic surfaces.

The construction of the bridge is in charge of the Hampden County Commissioners: Charles C. Spellman, chairman; George W. Bray, William H. Ensign, with Ely and Ely, of Springfield and Westfield, as legal advisers. The designs were prepared by Fay, Spofford and Thorndike, consulting engineers, of Boston, who are acting as supervising engineers during construction; Haven and Hoyt, of Boston, serving as advisory architects.

Bids for the bridge construction, opened March 10, were as follows: P. McGovern, $4,167,000; Holbrook, Cabot & Rollins with C. W. Blakeslee & Sons Co. (joint bid), $3,775,000; H. P. Converse Co., $3,254,883. The engineer's estimate was $3,399,000. The contract was awarded to H. P. Converse Co. of Boston.

Township Rewards Distributed

The Pennsylvania State Highway Department recently announced the proportion in which the $1,000,000 appropriated by the 1919 legislature for payment of state rewards to township supervisors is to be apportioned. The old system of bonuses to townships has been abolished, and in its place comes the method of distributing rewards for work actually accomplished by townships in road improvements. The money is apportioned among the various counties according to the mileage in townships of the second class. The mileage is compiled from map surveys made by the township division of the state highway department. There is a total of 74,875 mi. of township roads in townships of the second class, and the distribution therefore will be at the rate of $13.35 per mile. Cameron County with 125 will receive the smallest apportionment, and Lancaster with 2,567 mi. will receive the largest apportionment, this latter being $34,283.80.



PERSPECTIVE OF CONCRETE ARCH BRIDGE AT SPRINGFIELD, MASS.

Activated-Sludge Experiments at Worcester, Massachusetts

A Year's Study of New Process Showed It Not So Well Adapted to Worcester Sewage As Imhoff Tanks and Sprinkling Filters

By Ray S. Lanphear
Supervising Chemist in Charge of Sewage-Works, Worcester, Mass.

THE policy of the Worcester Sewer Department for the past sixteen years has been to operate experimental sewage treatment plants, testing the newer methods that gave promise of good results. It was appreciated that chemical precipitation of sewage was inefficient, in view of later developments, and that the sand filter area would be limited by the quantity of sand at the present disposal plant site. For two years, commencing July, 1911, the Imhoff tank-sprinkler filter method was investigated with excellent results, and in 1916, the superintendent of sewers recommended that a treatment plant of this type be constructed. About this time, the activated-sludge process became prominent and our policy required that it should be tried out before a definite decision was made. Therefore, an experimental activated-sludge plant was operated from July, 1917, to August, 1918, when the supervising chemist was asked to accept a commission in the Service and the work was discontinued. In spite of the sudden interruption, sufficient results were obtained to indicate that this method of treatment was not as satisfactory in many ways for Worcester sewage as was the Imhoff tank-sprinkler filter method.

General Description of Plant

The experimental activated-sludge plant consisted of a bar screen grit chamber, sewage aeration tank, sludge aeration tank, sedimentation tank, sludge concentration tank and a shallow tank used for concentration experiments and for measuring excess sludge previous to disposal. The details are shown in the accompanying plans. Sewage was taken from the outlet of the main grit chambers in a 6-in. pipe line to the screen chamber. From this chamber the sewage passed in a trough, by a swivel gate, where excess quantities of sewage could be wasted, to a grit chamber which was formed by a depressed section of trough bottom. The sewage flow was measured by a weir and hook-gage and then continued in the trough to the sewage aeration tank. Just before entering this tank, the sewage received the returned sludge.

The effluent from the sewage aeration tank passed in a trough to a point above the center of the sedimentation tank and was measured by a weir and hook-gage. The inlet to the sedimentation tank was a box of increasing area of cross-section which extended down into the tank about 8 ft. The effluent was collected in a circumferential trough and the sludge settling to the bottom of the tank was raised by air-lift and delivered in a trough, containing swivel gates, to the sewage aeration tank, sludge aeration tank or to the sludge concentration tank. The sludge, with or without reaeration, was returned to the sewage in a trough previously mentioned and was measured as the difference of the combined sewage and sludge and the sewage flows.

The equipment for furnishing compressed air included two 10-hp. single-phase motors, belt connected to two No. 2 Nash hydro-turbine compressors or blowers. The air used for aeration of sewage and of sludge was measured by venturi meters and that for the air lift, by a Westinghouse No. 12 gas meter. A pressure gage, thermometer and a waste valve were suitably installed. The air passed through cheesecloth screens and was washed in the compressors previous to use.

Preliminary Treatment of Sewage

The bar screen had ½-in. openings and its working area was about 4.5 sq.ft. The screen was cleaned hourly and an average quantity of 11.4 cu.ft. of screenings, containing about 149 lb. of organic matter, were removed per million gallons of sewage screened. In all oxidation processes of sewage treatment it has generally been found to be advantageous to remove much suspended matter by preliminary treatment, especially the coarse matters which could not be oxidized or which, on account of their physical character, did not readily permit of oxidation. Much of this matter would require oxidation in order to maintain good activated sludge and when the large quantity of air which was used with the screened sewage is considered, it is believed that screening would have to be practiced in connection with activated-sludge treatment of Worcester sewage.

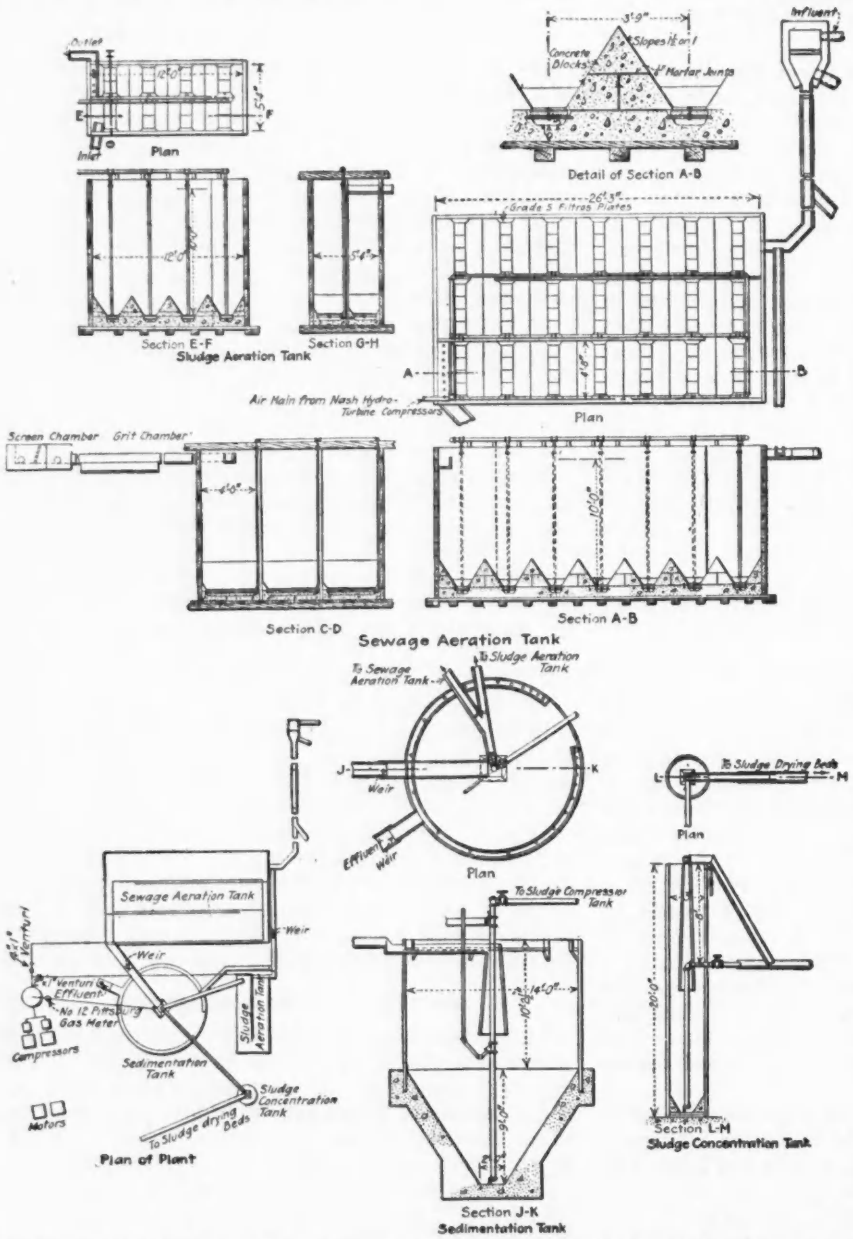
Removal of additional quantities of suspended matter by fine screens does not appear to be necessary for the successful operation of this process of sewage treatment. Fine screening of sewage might be attempted as a means of reducing the quantity of air required. On account of the character of Worcester sewage, with its apparently large oxygen requirement as shown in these experiments, it is believed that fine screening would not materially reduce the quantity of air required.

The grit chamber, 72 x 10 x 8 in. deep, was installed as a precautionary measure in case grit should pass the main grit chambers. Material removed from this chamber many times had a mineral content of from 70 to 80%, which is characteristic of deposit from grit chambers in regular use. Slight deposits did occur on some filtros plates, but the air distribution was also a contributing factor. This result indicates that when combined sewage is to be treated by this process, grit chambers must be carefully designed and operated if deposits in the sewage aeration tank are to be avoided.

Aeration of Sewage and Sludge

The sewage aeration tank was constructed of wood with a concrete bottom; it was 26 ft. long, 14 ft. wide and 10 ft. deep, from filtros plates to water level, and had a capacity of 25,283 gal. The tank was divided into three channels giving the sewage a travel of nearly 80 ft. The bottom of the tank was of saw-tooth construction, rows of four filtros plates, Grade "S," being placed 45 in. c. to c., giving a ratio of tank surface to working plate area of 5.2 to 1 per cent. Concrete blocks were placed between the rows of plates and had slopes of 1.5 on 1. Compressed air was delivered by a 4-in. header to three 2½-in. pipes, one for each channel. Each set of filtros plates was supplied with air by a 1-in. pipe which entered a chamber under each set of plates made by using a form when putting in the concrete bottom. Each of these pipes had a valve near the top whereby the quantity of air passing to each set of plates could be regulated. Much care had to be exercised in their use if trouble was to be avoided. This

method of installing the filtros plates proved very successful. Only a few leaks developed along the edges of the blocks where they rested upon the plates. Liberal and careful use of cement grout corrected the difficulties. The sludge aeration tank was of similar construction and had a capacity of 4,386 gal. The ratio of tank surface to air diffuser was 4.76 to 1.



GENERAL LAYOUT OF PLANT. DETAILS OF VARIOUS TANKS FORMING WORCESTER EXPERIMENTAL ACTIVATED-SLUDGE PLANT

Satisfactory results of the treatment of weak sewage required at least 4 hr. aeration of the sewage with at least 2 cu.ft. of free air per gallon. The sludge need not be reaerated and the quantity returned to the sewage should be about 20% of the sewage flow. At such times as the sewage is of weak character, the greatest dilution of the effluent will occur in the river. There was no nitrification of the effluent. The stability of the effluent was obtained by clarification of the sewage and reduction of its organic content. A total quantity of free air of 1.75 cu.ft. per gallon of sewage, together with 3.8 hr. aeration of the sewage and 3.1 hours reaeration of the sludge did not remove the color of the trade wastes from the sewage. With the above conditions of operation, the average stability of the effluent was about three days in a closed bottle at 20° centigrade.

Strong sewage required at least 6 hr. aeration together with not less than a total quantity of air of 3 cu.ft. per gallon. The sludge was reaerated from 5 to 6 hr. with about ¼ of the total quantity of air, while the quantity of sludge returned to the sewage was about 25% of the sewage flow. The possibility of eliminating reaeration of sludge while treating strong sewage was not determined on account of the interruption of the operation of the plant. With the above conditions of operation, the average stability of the effluent was about six days.

The factors of operation as given in the two preceding paragraphs are considered as minimum quantities and periods of time. If an average stability greater than 75% is desired, the results of operation indicated that the strong sewage will have to be aerated longer than 6 hr., the sludge reaerated at least 6.5 hr., using a total quantity of about 4 cu.ft. of free air per gallon. The quantity of sludge returned to the sewage would be slightly more than 25% of the sewage flow.

The quantity of sludge returned to the sewage was regulated according to the results of a 30-minute settling test of the effluent of the sewage aeration tank. The effect of variation of the density of the sludge upon the bulk of solids necessary for the clarification of the sewage are offset by maintaining a uniform percentage of sludge according to this test. This test was also an excellent indicator of the character of the sludge and the effect of the quantity of sludge returned. Excessive quantities of sludge without sufficient solids always produced an unsatisfactory effluent possessing a yellow or brown color.

Filtros plates proved satisfactory for the diffusion of air into the sewage and sludge. Each 1-in. pipe was fitted with a union so that pipe distributors could have

been substituted for the plates. No baffles were used in either aeration tank, but plans had been made to put them into the sewage aeration tank. The filtros plates in the sewage aeration tank were not brushed; this was done once and apparently did no good. Foaming occurred in the sludge reaeration tank when the sludge was of very poor quality for activated sludge and a light voluminous scum formed if changes were not made to improve conditions. Aeration of the sewage tended to separate the grease and a scum formed on the trough to the sedimentation tank and a yellow mass of grease tended to collect on the water in this tank.

Worcester Sewage Contains Much Trade Waste

The quantity of air and the period of aeration required for treating Worcester sewage are greater than those which have been considered as possible for use at other places. Our sewage contains much trade-waste of varying character and quantity and this process of sewage treatment has been found to be very sensitive to such changes. This is due to the stability of the final effluent being entirely dependent upon the degree to which organic matter of the sewage has been removed, since there has been no nitrification of the effluent and it contains only a small amount of dissolved oxygen. For these reasons, this process does not give uniformly good results with similar conditions of treatment. It was shown that with a sewage such as we have, a great flexibility of operation must be provided and this in itself presents an operating condition of greater concern than is found in any other method of sewage treatment. It was impossible to operate with what might be considered a real minimum quantity of air and periods of aeration.

The sedimentation tank was of the Dortmund type, 14 ft. in diameter and 9.6 ft. deep, with a conical bottom, 9 ft. deep, with slopes of 1.5 on 1. The capacity of the tank was 11,058 gal. in the circular section and 4,017 gal. in the conical bottom. During operation, the conical bottom was usually kept filled with sludge as an aid in returning to the sewage sludge possessing sufficient and uniform density. The sludge did not slide down this slope readily and a sqeegee was used. Based on the circular portion of the tank, the sedimentation period varied from 1.6 to 2.9 hours.

Experience with this type of tank indicated that it was not particularly suited for the purpose. A shorter period of sedimentation was possible, but means are necessary for keeping the tank as free as possible of sludge and at the same time obtaining sludge with a reasonable density.

While the final effluent contained no nitrogen as nitrates and very little dissolved oxygen, the clarification was generally excellent. This is attributed to the presence of ferrous sulphate in the sewage, which was oxidized and an excellent precipitant formed. This ferrous sulphat was also the cause of considerable of the large air consumption.

The results of chemical analyses of the sewage and final effluent showed a general lack of reduction of free ammonia, considerable reduction of albuminoid ammonia and oxygen consumed and absence of nitrification of the effluent. The removal of suspended solids was generally from 85 to 95% and the precipitation of iron was usually about 90 per cent.

There appeared to be a considerable range of relative stability of effluents having from 0.110 to 0.160 part per 100,000 of albuminoid ammonia and that it was necessary that this content be below 0.200 part if at least 75% relative stability was desired. Effluents containing less than 0.200 part did not always have a stability greater than 75%. The quantity and character of the finely divided particles of suspended solids in the effluent exerted considerable influence upon the methylene blue test. The percentage of saturation of dissolved oxygen of the final effluent usually varied from 20 to 60 in the morning and from 0 to 40 in the afternoon. Many determinations were from 20 to 30%. The dissolved oxygen demand of the sewage, three days incubation at room temperature, varied from 130 to 216 p.p.m. and of the effluent, from 9 to 40 parts, a reduction of from 75 to 95 per cent.

High Range of Bacterial Content

The variation of bacterial content per cubic centimeter was as follows: Screened sewage, 750,000 to 2,500,000; final effluent, 50,000 to 350,000; effluent from sewage aeration tank, 3,000,000 to 6,000,000; both influent and effluent of sludge reaeration tank, 6,000,000 to 30,000,000. The best results were obtained when maximum periods of aeration and quantities of air were used, when the reduction of bacteria was about 97.5%. When the final effluent was of good chemical quality, but not perfectly stable, its bacteria content increased to from 50,000 to 100,000 per c.c. During the winter these figures increased to from 150,000 to 350,000. The results of the second summer did not approach those of the first, being much like those of the winter. This is explained as being due to the use of less air and shorter periods of aeration. The variation in the bacterial content of the sludge bore no direct relation to the variation of the quantities of air used or the period of aeration. When the sludge was not reaerated its bacterial content was about 15,000,000 per c.c. There was a plainly indicated range of bacterial content of the final effluent according to its quality, the bacterial content of the sewage aeration tank effluent appeared to be quite uniform, while that of the sludge varied considerably and in such manner that no well defined limits can be given for good activated sludge.

The suspended solids in the final effluent were determined daily by the Gooch method and usually varied from 0.7 to 3 parts per 100,000 when the chemical analysis was good. With a poor effluent the quantity increased two to three times. During such a period, the putrescibility test was made on filtered samples as well as total samples, the filtered samples having a stability of 99 as compared with from 55 to 72 for the unfiltered samples. These results indicate the marked effect of suspended solids upon the stability of the effluent and the necessity of always obtaining a clear effluent if high stability is desired.

Special samples of final effluent collected for the determination of nitrates and nitrites gave results which verified the analyses of the composite samples and showed that nitrification was not taking place.

Worcester sewage is apparently of such character that nitrification does not take place readily with this process of sewage treatment. A stable effluent can be obtained by oxidation of the organic matter and its reduction to a quantity fully as small as that which is present in our sand filter effluent. The lack of nitrification and the low dissolved oxygen content of the final

effluent furnish no factor of safety. As a rule, biological methods of sewage treatment produce such factors and in this way, sewage of varying character can be cared for. With the activated-sludge process of treatment of Worcester sewage it would be practically impossible to operate and constantly obtain uniformly good results. This was well shown by our inability to duplicate the results of 1917 during July and August, 1918.

The Resulting Activated Sludge

Activated sludge was always of brown color, the particular shade of which was very variable and apparently due to changes in the character of the sludge. The sludge was usually of flocculent character and when mixed with water or sewage settled rapidly. When the sludge was very dark brown in color, indications pointed toward insufficient aeration and the flocculent character disappeared. If the color of the sludge became very light brown, it was necessary to observe that overaeration was not changing the flocculent condition to one of finely divided solids which did not readily separate from sewage or water. The odor of good activated sludge was generally characterized as earth or that of humus matter and, when not so good, it possessed an odor of decaying angleworms, similar to that of final settling basin sludge after sprinkling filters. Undoubtedly, the best means of ascertaining the character of the sludge is the test of putting a small quantity of sludge into water and observing the manner in which it settles. The test was made by putting about 50 c.c. of sludge into 450 c.c. of water contained in a 500 c.c. cylinder.

The quantity of sludge produced per million gallons of sewage varied from 12,000 gal. in the summer to 25,000 gal. in the winter. Both quantities are much greater than have been produced by any other process of treatment of Worcester sewage. The density of the sludge varied from 97.1 to 98.7% moisture. The dried sludge contained from 50 to 70% of organic matter, from 8.5 to 18% of iron, from 2 to 9% of fats and from 4.0 to 6.5% of nitrogen. While this quantity of nitrogen is greater than that of any other Worcester sludge, it is believed that the results and cost of sewage treatment are not such that any material advantage can accrue from this increased nitrogen content of the sludge.

Fertilizer analyses of dried activated sludge of four periods averaged the following percentages: Total nitrogen, 4.06; available nitrogen, 1.39; total phosphoric acid, 2.26; citrate insoluble acid, 0.50; citrate soluble acid, 1.76. In our earlier experiments, dry Imhoff tank and final settling basin sludges gave the following average percentages, respectively: Total nitrogen, 2.61, 2.42; available nitrogen, 1.25, 1.71; total phosphoric acid, 1.66, 3.43; citrate insoluble acid, 0.46, 1.16; and citrate soluble acid, 1.20, 2.27. The potash was not determined on account of the small quantity contained in Worcester sewage sludge, usually less than 0.05 per cent.

The ultimate treatment of activated sludge to render it fit for disposal, commercially or otherwise, has not yet been satisfactorily determined at any place. The greater part of our sludge was air dried upon sand drying beds, but this was demonstrated to be impracticable on account of the small depth which could be applied. If more than 4 or 5 in. were put on to a bed, the sludge settled rapidly and water was left on top, which had to evaporate before actual drying commenced. The dose of sludge could only be of the size from which the bulk of the water would drain during the application to the bed. Concentration of the sludge improved results very slightly. These small doses of sludge dried quickly, cracking of the dried sludge commencing after 24 hr., and it could be removed at the end of the second day.

Concentration of sludge for from 15 to 24 hr. decreased the volume to be handled about 50% and its water content from 98 to 96%. In no case were we able to obtain sludge containing less than 95% of water. Better results of concentration of sludge can be obtained if the activated sludge is in a flocculent condition. Experiments with various containers demonstrated that a concentration tank having its depth from one to six times its diameter or shorter side would prove most efficient. The only virtue of a deep tank was that heavier sludge could be obtained if longer periods of concentration were used. Small changes of temperature did not materially affect the concentration of sludge.

One of the essential requirements of this process of sewage treatment, without consideration of the large quantity of air necessary for sewage treatment, was that our present installation of sludge presses should be satisfactory for handling activated sludge. It was demonstrated with a small section of one press that the press cake could not be formed, with or without the aid of lime, in less than 1½ hr. with 70 to 90 lb. pressure. Lime increases the cost of operation and decreases the commercial value of the press cake. Compressed air and water were used for forcing the sludge into the press with apparently no difference in the results. Radial streaks of soft sludge were invariably present, making the cloths hard to clean and the cake unsatisfactory for disposal. Radial sticks were sewed on to press-cloths with the result that the streaks of soft sludge became narrower. The results indicated that the present form of our press plates was unsatisfactory for use with activated sludge, the volume of a single press cake being too great. Apparently, the form of press and plates should be such that the cake would be dewatered to some 75 or 70% in about 30 minutes.

Activation vs. Imhoff Tank-Sprinkling Filter

The effluent from activated-sludge treatment of Worcester sewage was of much better appearance and chemical analysis than that from the sprinkling filters when sufficient air was used to obtain a stable effluent. These are absolutely the only points in favor of the process from the sewage treatment point of view. The organic content of the filter effluent was only slightly more than 0.200 part per 100,000 of albuminoid ammonia and its stability was perfect during a greater part of the year, even when operating at a rate of 2,000,000 gal. per acre daily at Worcester. The filters will take a temporary overload without additional cost of operation. The quantity of sludge to be handled by the activated-sludge process is from four to eight times that produced by the Imhoff tank-sprinkling filter process. We have been able to dispose of a large proportion of our press cake by giving it to farmers, and it is anticipated that the Imhoff tank air-dried sludge can be disposed of in a similar manner. It is considered that the cost of operation as concerns the quantity and class of labor required is entirely in favor of the Imhoff tank-springling filter process of sswage treatment. It is a well known fact that the cost of sewage treatment by the activated-

sludge process where the air requirement is much less than for Worcester sewage has been considered prohibitive unless sufficient income was to be derived from the disposal of the sludge to admit of the process being adopted.

Aside from a consideration of all the above facts, the activated-sludge process of sewage treatment is considered unsatisfactory for Worcester sewage for the reason that it does not give uniformly good results under apparently similar conditions of operation. No factors of safety are present to offset the demands made upon the method of treatment by the constantly changing character of the sewage.

The experimental plant was designed and operated under the direction of Matthew Gault, superintendent of sewers, the writer serving as supervising chemist in charge of the sewage treatment works.

Progress in Engineering Education at Columbia University

(Abstract of Annual Report of President Nicholas Murray Butler)

IN HIS recently published annual report Dr. Nicholas Murray Butler, president of Columbia University, discusses at some length the "Problems and Standards of Engineering Education." Under this title he has stressed what is becoming widely recognized as the major deficiency in the education of engineers—lack of broadness, the humanities—and has described the remedial efforts and success of the Columbia Schools of Mines, Engineering, and Chemistry. The succeeding paragraphs are a partial abstract of Dr. Butler's report:

The outstanding part that engineering and engineers have played in the war and the large amount of attention given to intensive training of men in technical subjects by both the Army and the Navy have just now directed increased attention to the long-discussed problems of engineering education. Wherever these problems are seriously and capably discussed, it seems to be agreed that while engineering schools may have turned out well-trained graduates, those graduates have not been on the whole sufficiently well-educated men. Of late, committees of some of the engineering societies have been asking the question: "Do engineers as a group have the same standing and influence in their communities as men in other professions?" They fear the answer is in the negative and many allege as the reason that engineers are on the whole not so well educated as their contemporaries in other professions. However this may be, it is a fact that, coincident with the growing importance of engineers in public life, the requirements of the times are setting broader standards of education for the engineer. For example, a report just issued by the Committee on Development of the Institute of Electrical Engineers and endorsed by the institute in convention declares squarely in favor of a six-year course in electrical engineering, two years of this to be given to the study of the humanities.

Two 3-Year Courses

The faculty and trustees, aided by the advice of a committee of alumni, determined in 1912 upon Columbia's present arrangement for the education of engineering students; that is, a three-year professional course of engineering in its several branches based on admission requirements to be met ordinarily by not less than three years of college work, including specified and thorough training in mathematics, physics and chemistry. An arts curriculum in Columbia College, requiring, besides the foregoing courses in the humanities and in elementary drafting has been prepared as a pre-engineering course. Completion of this course and the first year of the engineering course entitles the student to the A.B. degree or completion of the Columbia College course and one of the applied science courses entitles the student to the degree of A.B. and B.S.

Viewed in detail, two ideas with respect to this curriculum were dominant. First, that for reasons relating directly to his achievements in practice as well as for his own self-satisfaction, the engineer has need of a broader education in the humanities than can reasonably be arranged in a four-year course, for the engineer needs the broader outlook on life that comes from contact in college with men who have other than the engineering viewpoint. Second, that the effective method of arriving at a higher standard in the study of engineering subjects is to base this study on the more thorough and scientific training in the fundamental sciences of mathematics, physics and chemistry.

Less Than 30% of Engineering Students Graduate

No less cogent were certain considerations relating not directly to the content of the curriculum, but to the membership of a student body. Fewer than 30 per cent of the students who enter engineering schools remain to graduate. Many of those who do stick it out would have done better to have followed other courses. The decision to attend an engineering school is usually made at an early age and frequently on insufficient ground, but, once in, the student who is good enough to hold his place is likely to desire to finish the course. This means that even after the inevitable clearing out of the large mass in the first and second years of the usual four-year course, there are left a considerable number of students whose influence is inevitably to depress the standards of instruction, who cannot be dropped from the schools but who would certainly be more in place in some other system of training.

The clear differentiation in the present program between the undergraduate work and the professional school work, together with the deterring influence of the longer course upon those whose resolve is not firmly established, operates to collect in the professional engineering schools a group of men of sound and homogeneous preparation, each of whom is there for a good reason. The interaction of the minds of these well-selected students on one another is by no means one of the least important features of this arrangement and the possibilities of a much higher standard of instruction is obvious. As for those other students who may have spent one or more years in college looking forward to an engineering course only to discover that their real interest lies elsewhere, they are when in college in the very best situation for directing their attention to preparation for other fields of labor. The present course appeals to a special class of students who desire the broadest, most thorough education for the engineering profession and have the faith that their own ability and character are worth the investment of six years of college and professional schooling. The members of the teaching staff find that the superior preparation and the more determined interests of the students do indeed enable a much higher standard of instruction to be set.

Pre-Engineering Students.

The pre-engineering students are not encouraged to consider themselves a separate group in Columbia College; in their classes they are naturally rather grouped by themselves, but they do not study "engineering history" or "engineering English"; they are simply encouraged to get the best there is out of American college training and college life. Many students begin the pre-engineering course who do not finish it, or who take it not at all as a preparation for engineering but as an excellent academic course with major interest in the physical sciences. Of the students in college who have at some time started in to take this course, more than half have not completed or continued it. In the main these were students who found that their interests merely lay in other directions and who turned from the engineering course to other college work more desirable for them with no difficulty or embarrassment.

Pile and Concrete Piers for Missouri River Bridge

Scour and Ice as Factors in Planning Reconstruction and Special Pier Design for Truss Spans of Milwaukee Railway Briidge

TIMBER pile piers carrying two 300-ft. steel truss spans constitute a notable feature of the new Missouri River bridge for the Chicago, Milwaukee & St. Paul Ry., at Chamberlain, S. D., since piers of this type are rarely used for structures of such size. Deep piling in soft material and the use of concrete reinforcing slabs and concrete-faced ice-breakers render these large piers of exceptional interest, the slabs representing novel development in pile pier design. War, engineering, traffic and finance conditions all combined in leading to the adoption of this type of pier.

When the branch line from Chamberlain to Rapid City was built in 1905 a 1,500-ft. pile trestle was used for crossing the Missouri River, with a 366-ft. pontoon for a draw span. Floods and ice caused continual trouble in maintaining the trestle, and in 1918 the pontoon had become so leaky that it was necessary to remove it, a temporary 75-ft. plate-girder swing span being put in its place and carried on pile piers.

To reduce the maintenance troubles, it was planned to build a more permanent structure, having long spans to give clear passage for ice and flood waters. The present site is unfavorable, however, since it would require long and expensive work in the construction of deep foundations for masonry piers. Further, it was considered desirable to relocate the line to secure a high-level crossing without a drawspan at a site some distance downstream, but the policy of the U. S. Railroad Administration was opposed to the undertaking of such an extensive and costly railway and bridge project during the war.

Under these conditions, a plan was adopted for replacing part of the old trestle with two 300-ft. truss spans supported on pile piers, and installing a new 262-ft. draw pontoon at the east end. A practically permanent structure was obtained in this way, the problem of relocation being left for some future time when traffic and other conditions warrant its consideration. As the country is low and flat, the railway rises to the level of the bridge by approach grades of 0.6 per cent.

Ice and scour were two special difficulties to be considered in the design of the piers. In the first place, the great quantity of ice coming down in the spring made it imperative to provide resistance to and protection against the heavy pressure exerted against obstructions, especially if the flow is checked so as to form an ice jam. In the second place, the sand and alluvial silt which form the river bed for a depth of 20 ft. or more, fills in during normal flow and is scoured out by the high current velocities at flood periods, the depth of scour ranging from 10 to 30 ft.

Long piles and a concrete diaphragm or slab connecting them so that they act as a unit in resisting pressure were the means adopted for insuring stability of the piers. Protection against ice pressure is provided by extending the pier upstream as a timber crib to form a large ice breaker, the inclined nose of which is faced with concrete. For protection against scour, the river bed around each pier is covered with a mattress of willow brush. This was woven on scows which dropped downstream as the mattress was launched, and sunk by loose rock thrown upon it from barges, while rock is also deposited around the base of the pier.

Seven rows of piles are used for the pier proper, spaced 2 ft. c. to c., with twelve piles in each row and

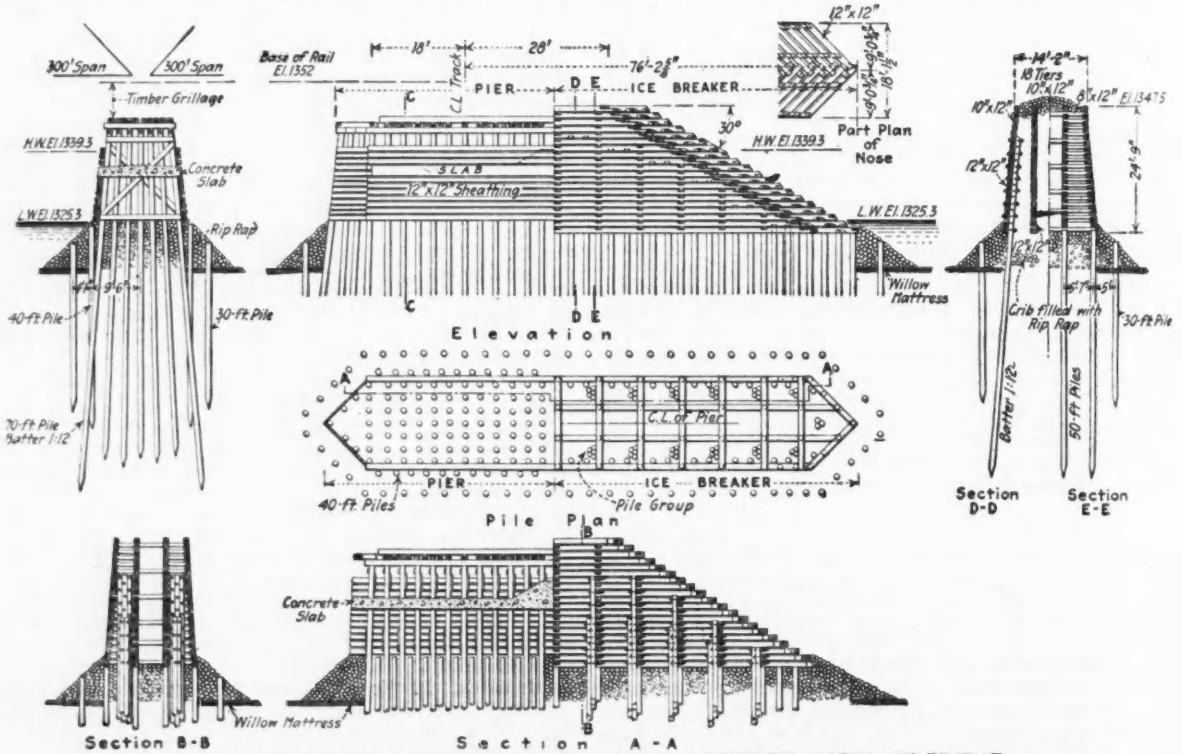


FIG. 1. PILE PIERS WITH CONCRETE DIAPHRAGMS FOR CHAMBERLAIN BRIDGE

with the caps about 3 ft. above high-water level, the outer piles being battered. This construction is shown in Fig. 1. Cedar piles 70 to 80 ft. long are used, with a penetration of 30 to 50 ft. below the river bed, all piles being driven to refusal in the sand and gravel underlying the silt. Longitudinal timbers 12 x 12 in., 3 in. apart, are bolted to the batter piles to form a fender or sheathing which prevents the ice from lodging against the piles, while plank sheathing is spiked to the downstream end of the pier. To hold the riprap in place, a line of 30-ft. piles is driven all around the outside of the pier, and a row of 40-ft. piles along each side; the heads of these piles are cut off below low water, the projecting ends being covered by the stone fill.

Midway between high and low-water levels is a concrete reinforcing slab held in place by 12-in. spikes driven partly into the piles so that their projecting ends are embedded in the concrete. Its thickness is 30 in., increased to 66 in. at the upstream end to afford a bearing for the cribwork of the icebreaker. The concrete is a 1:2:4 mix reinforced with longitudinal and transverse bars at top and bottom, the transverse bars being looped around the outer piles. A plank platform supported on timbers spiked temporarily to the piles served as the bottom form, and the concrete was well rammed so that after taking its final set it would fit tightly against the piles.

A concrete slab or deck to cover the top of the pier and form the bridge seats was included in the original

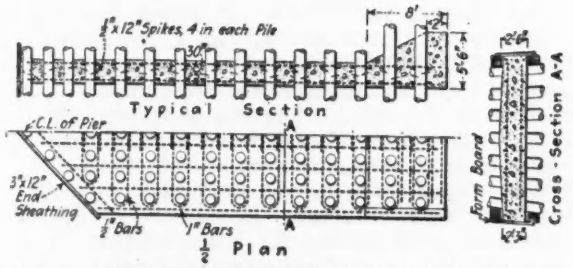


FIG. 2. CONCRETE REINFORCING SLAB FOR TIMBER PILE PIER

design, as in the Platte River bridge of the Rock Island Lines described in *Engineering News-Record*, Feb. 5, 1920, p. 237. Construction of the Missouri River bridge was delayed, however, until so near the opening of spring in 1919, that it was considered inadvisable to delay the steel erection for the time necessary for the placing and setting of the concrete. A timber grillage therefore forms the deck of the pier, upon which the shoe castings for the truss spans are placed. As protection against fire from engine sparks and cinders the entire top of the pier is covered with a sheeting of galvanized steel.

The icebreaker, which is built integral with the pier proper, has four-pile bents spaced 8 ft. c. to c. and of varying height, all piles being 65 to 75 ft. long. Each bent is capped and behind each cap are two groups of five piles, while longitudinal struts between the piles of the two inner rows, forming part of the cribwork, assist in making a very rigid structure. This crib is filled with stone, and riprap is placed along the outside, over the heads of the anchor piles noted above. The horizontal sheathing of the pier is extended along the icebreaker.

Reinforcing bars were laid along the timbering at the slope of the nose of the icebreaker, and concrete was filled over the timbers and bars, with a minimum thickness of 12 in. At the ridge it is faced by a line of old rails embedded flush with the concrete and anchored by U-bars passed through holes in the web. To prevent scour at the nose, the concrete is carried down about 5 ft. as a toe wall in front of the first set of piles, the rail also being extended to the bottom of this wall.

Pile driving was done largely by two railway pile drivers on the trestle, one of these having a steam hammer and the other a 2-ton drop hammer, while both were equipped with water jet apparatus. For work outside

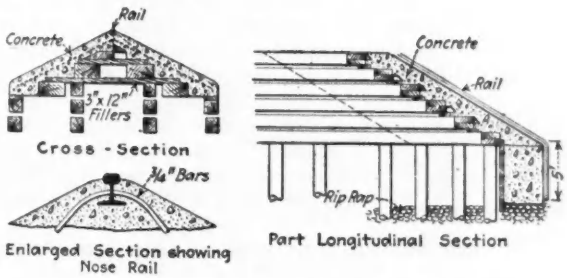


FIG. 3. CONCRETE ICEBREAKER OF PILE PIER

their reach, the power boat or scow for operating the pontoon was equipped temporarily with leads, a steam hammer, a steam pump for the jet pipes and a centrifugal pump with flexible suction pipe for excavating sand bars formed at the pier sites. When working above the bridge, the boat was held in position by lines leading to an anchor block sunk in the river, while for work below the bridge these lines were attached to the old trestle.

All construction work, including erection of the steel spans, was done by the railway company's forces, under A. Daniels, district engineer, and W. E. Duckett, resident engineer. The plans for the piers and truss spans were prepared by H. C. Lothholz, then engineer of design. The design and construction were under the direction of Charles F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul Ry. The substructure was commenced in July, 1918, and was ready for steel erection in January, 1919, the spans being completed early in March. The new pontoon was launched and installed in April, when the ice went out.

To Promote Public Hydro-Electric Projects in Georgia

Government-owned hydro-electric developments are to be urged by an organization known as the Municipal League of Georgia, with headquarters at Albany, Ga., with M. W. Tift, mayor of that city, as president. The League was organized about a year ago, for the purpose of defeating a bill in the legislature intended to prevent towns and cities in the state from owning their own light and power plants. It is now devoting its attention to the development, under state control, of municipal ownership of all the hydro-electric energy that will be required for the use of the state. The membership is composed of mayors and other officers of the towns and cities of the state, and each town or city has one vote in the direction of affairs, regardless of the size of the city.

Concrete Roadbed for Track, Tunnels and Stations

Ballasted and Unballasted Track on Concrete Slabs on Soft Ground Gives Good Results—Rigidity and Resilience Basis of Different Designs

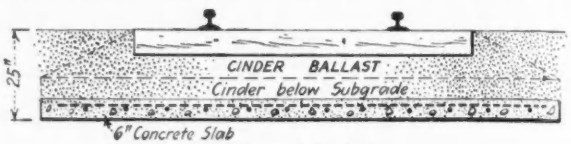
A CONCRETE slab base under railway track to secure increased stability and decreased maintenance has been tried with success, though on a small scale, by several railways, mainly where soft roadbed is a factor in maintenance work. Particulars of some of these experiments are given in the 1920 report of the ballast committee of the American Railway Engineering Association, from which much of the following information is taken. Such construction in open track is a different matter from the use of concrete floors in terminal stations and submarine tubular tunnels, but reference is made also to installations in such places and in ordinary railway tunnels. No reference is made in the report as to the use of concrete slabs at highway crossings, although this has been tried by some steam and electric railways in order to reduce the maintenance work required at such crossings. The designs of track construction with concrete bars are of distinct types, one having the ordinary ballasted track laid upon the slab, while in the other the rails are carried by wood blocks or stringers laid directly upon the concrete.

FIG. 1. CONCRETE SLAB UNDER MAIN LINE CROSSOVERS, LONG ISLAND R.R.

Slabs Under Ballasted Track

On the Long Island R.R. there are three installations of slabs under ballasted track. One of them is at Jamaica, N. Y. Here there is a complicated track layout with numerous crossovers and slip switches carrying a heavy traffic of 550 to 800 trains daily, with a large amount of switching. When these tracks were elevated and rebuilt in 1912, on a sand and gravel fill 20 to 30 ft. high, it was considered that additional expense would be justified in securing a stable roadbed and reduced maintenance cost by giving an increased and continuous bearing. Stone ballast and 100-lb. rails are used.

Concrete slabs are placed under the cross-overs and at other points, being of irregular shape and size to conform to the lines of the tracks. Their outer edges are 5 ft. from the center lines of these tracks and their ends are just beyond the switch points. As shown by the typical section, Fig. 1, these slabs are 8 in. thick, slightly cambered in cross-section. The concrete is a 1 : 3 : 6 mix, and as local gravel was used the cost of the slab in place was only about 10c. per sq.ft. Although the slabs have never been uncovered, except on small areas, there are no indications of their having cracked or broken to such extent as to interfere with their usefulness. In seven years there has been very little expense for track maintenance and only two renewals of frogs or switch points.



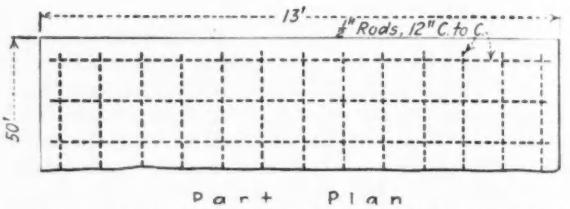


FIG. 3. CONCRETE SLABS SUPPORT TRACK ON SWAMP, NEW YORK CONNECTING R.R.

On the six-track Woodside-Winfield cutoff, built in 1914, there are numerous diagonal intersections of streets, involving a series of bridges. The gravel fill is about 20 ft. high and in order to prevent the settlement which frequently occurs at the back of bridge abutments, the roadbed was covered at several points

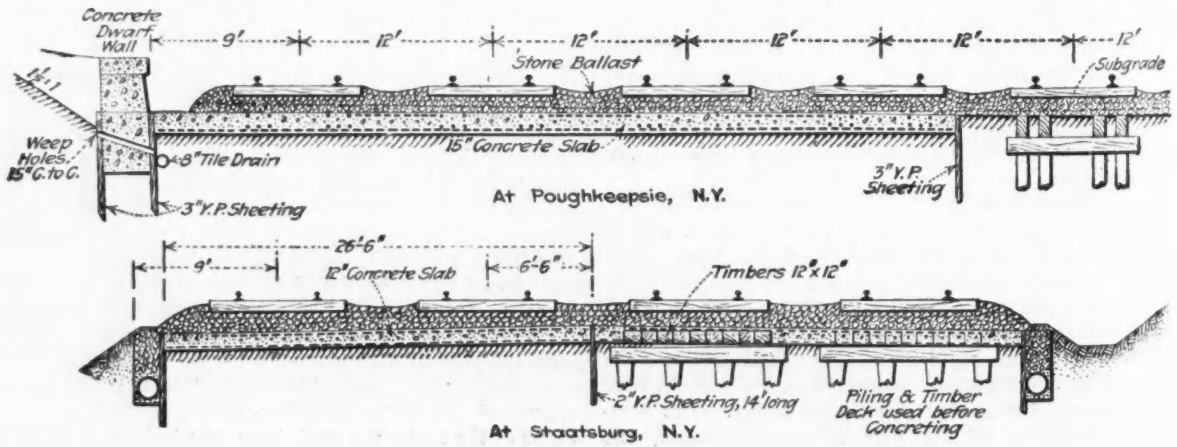


FIG. 2. CONCRETE SLABS ON SOFT ROADBED, NEW YORK CENTRAL R.R.

with 8-in. concrete slabs. At the Bay Ridge ferry landing, where heavy locomotives handle about a thousand cars daily to and from the floats, concrete slabs were placed in 1916 on a fill of silt and riprap. Each slab is about 200 ft. long, carrying two tracks with a double cross-over connection.

Monolithic slabs over the roadbed have been used at two points on the main line of the New York Central R.R., under the direction of George Kittredge, chief engineer. These are shown in Fig. 2. In widening for six tracks at Poughkeepsie in 1909, the soft

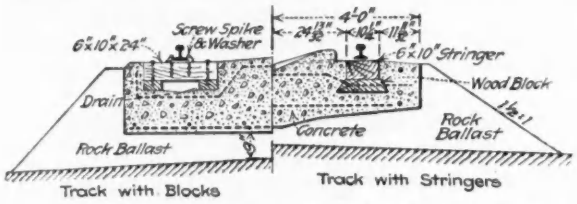


FIG. 4. CONCRETE SUPPORTS FOR UNBALLASTED TRACKS, NORTHERN PACIFIC R.R.

blue clay caused considerable difficulty and it was decided to carry two tracks on piles while building a concrete slab on the roadbed for the other four tracks. This slab is about 50 ft. wide and 15 in. thick, reinforced on top and bottom with ⅝-in. bars and having extra longitudinal bars in the bottom under each rail. There are three slabs of 100 ft. to 425 ft. in length, built where the soft spots occurred. They cost about $5.70 per linear foot of single track and have proved effective under a traffic of nearly 100 trains daily.

Similar troubles with soft roadbed were experienced in grade reduction and four tracking at Staatsburg, N. Y. Piling with caps and a solid floor of longitudinal timbers was used to carry two tracks while a concrete slab was built to carry the others, as shown in Fig. 2. Here the slab is 12 in. thick, with wire mesh reinforcement, and its cost was about $5.60 per foot of single track. This construction extends for about 3,800 ft. and it has proved quite satisfactory.

The New York Connecting R.R. (Pennsylvania R.R. System) has two stretches of concrete slabs 100 ft. and 150 ft. long where it crosses Juniper swamp. These slabs are separate for each track; they are 6 in. thick, 13 ft. wide and in lengths of 50 ft., reinforced at the top, as shown in Fig. 3. In one case there has been a slight settlement but there are no indications of failure in any of the slabs. Less maintenance is required than beyond the slabs, while part of the adjacent track requires excessive maintenance and the swamp clay has worked up through the cinder ballast.

On the Southern R.R., a number of soft spots in roadbed have been covered with concrete slabs since the first experiment of this kind was made in 1911. The purpose is to avoid the great expenditure of time and material by section forces in maintaining the track in line and surface over these soft spots or water pockets. The

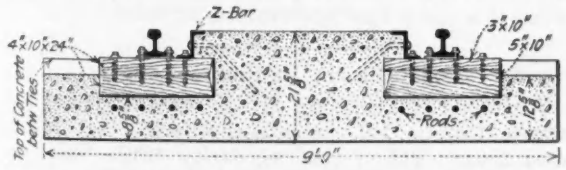


FIG. 5. CONCRETE ROADBED, CHICAGO JUNCTION R.R.

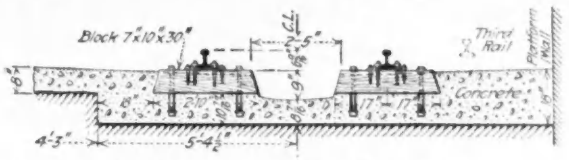


FIG. 6. TYPICAL CONCRETE FLOOR CONSTRUCTION FOR TUBE TUNNELS AND STATIONS, PENNSYLVANIA R.R.

slabs are 15 to 60 ft. in length. They have proved successful, track at one bad place having had to be tamped only once in the two years since the concrete was placed. During construction, the track is carried by bridge ties supported on stringers parallel with the rails, trains being run then at reduced speed.

Concrete roadbed construction on open track without ballast has had its most extensive trials on the Northern Pacific R.R., where three single-track stretches of different types aggregating 1,998 ft. in length were laid in 1914, as described in *Engineering News-Record* of Dec. 12, 1918, p. 1,071. Their cost was $7 to $10.65 per lineal foot, and in the following four years only $454 were spent for lining and surfacing. Short transverse blocks were used in two of the designs and longitudinal timbers in the third, as shown in Fig. 4.

On the Chicago Junction Railway, a 500-ft. stretch of track carrying heavy traffic was laid in 1911 with a concrete slab having the rails carried on short wood blocks

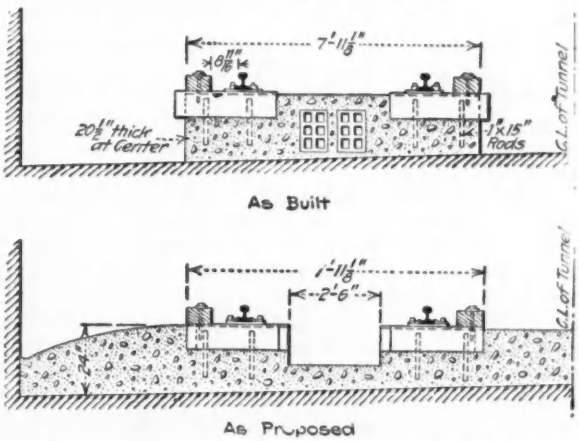


FIG. 7. RIGID CONCRETE TRACK FOR TUNNELS, DELAWARE, LACKAWANNA & WESTERN R.R.

spaced 34 in. c. to c. It will be noted by Fig. 5 that the concrete was very thick between the rails and was faced with Z-bar guards anchored to the concrete. Each rail block was in two parts, held in place by screw spikes through the bottom flanges of the Z-bars. Removal of the spikes enabled the upper block to be slipped out and the lower block could then be lifted from the pocket in the concrete. This construction required half a cubic yard of concrete per foot of track.

Track floor construction with ties and short blocks, used by the Pennsylvania R.R. for its station and submarine tunnels at New York, is shown in Fig. 6 and is typical of designs used in other similar stations and tunnels. It is adopted mainly for the purpose of reducing maintenance work and enabling the floor to be kept clean, for in the Pennsylvania station it is laid on a rock base. It is of interest to note also that this design has been adopted for the new elevated track floor of the

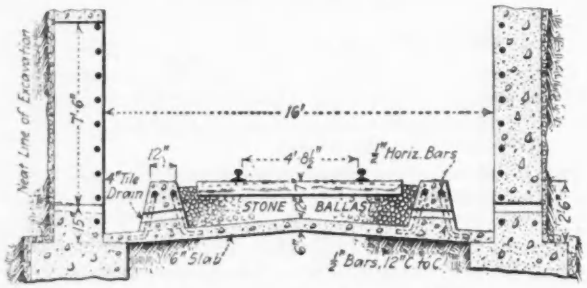


FIG. 8. CONCRETE BASE AND DITCHES FOR BALLASTED TRACK IN TUNNELS, NORFOLK & WESTERN R.R.

Union station at Indianapolis, Ind., as shown in *Engineering News-Record* of July 10, 1919, p. 86.

A concrete track support without ballast was used in the Bergen Hill tunnel of the Delaware, Lackawanna & Western R. R. in 1909, being designed by Lincoln Bush, then chief engineer, with the special purpose of forming a rigid roadbed. This was described in *Engineering News*, Aug. 19, 1909, p. 190. As shown in Fig. 7, it provides a separate and massive base for each track. Its cost was $14.26 per foot of double track, including the vitrified conduits for electric cables, while a ballasted floor with conduits and tile drains was estimated to cost $14.71 per foot and a saving of 40 per cent was predicted in cost of maintenance and renewals.

This tunnel is 4,280 ft. long and carries heavy traffic, but during 1917 and 1918 the total expense for maintenance was only $298. The concrete roadbed stood up well, but there has been some difficulty in removing the spikes and in spacing rail when relaying. A modified design suggested by Mr. Bush provides for a monolithic concrete floor over the entire width of the tunnel, as shown in Fig. 7.

A concrete slab construction for tunnels, providing for ballasted track between curb walls to form large side ditches, is shown in Fig. 8. This was designed by J. E. Crawford, chief engineer of the Norfolk & Western R. R., to meet the special conditions of this road. As there is a very heavy traffic of soft coal the fine coal dust tends to clog the ditches, interfering with drainage and causing considerable maintenance expense due to cleaning the ditches in the tunnels. The design, which provides for both single track and double track construction, includes a 6-in. concrete base with curb walls to retain the ballast and keep it out of the ditches. Weep holes provide for drainage of the ballast. The tunnel would be of such width that men could work in the ditches and be clear of trains. This design has not been applied in practice.

An unusual tunnel track construction shown in Fig. 9 was laid in 1916 for about half a mile in a freight tunnel under the city of Buneos Aires, Argentine Republic. This was adopted after experiments on a stretch of track in the open air. Full length ties are used, having the ends seated in pockets in concrete sills or stringers. As the rails are on the unsupported portion of the ties the construction gives resilience instead of rigidity.

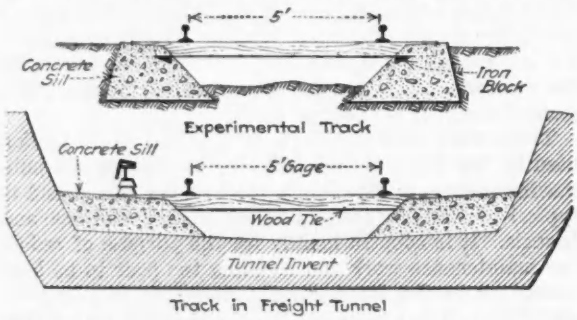


FIG. 9. RESILIENT TRACK CONSTRUCTION FOR TUNNEL, BUENOS AIRES WESTERN RAILWAY

This construction, built as shown in Fig. 9, was found to give less pounding and an easier riding track than when the concrete supports were placed directly under the rails. It was designed by Wm. Lowe-Browne, assistant general manager (then chief engineer) of the Buenos Aires Western Ry., and was built under the direction of H. E. Boardman, then principal assistant engineer.

Higher Duty of Irrigation Water

By George Ebner
Operation Manager, the Valier-Montana Land & Water Co., Valier, Mont.

THE unprecedented shortage of stream flow over the greater part of the Western states during the past year has resulted in awakening the public to the greater need of irrigation development and of increasing the storage facilities to lessen the loss of water. Many constructed projects are seeking additional storage and the matter of further reservoir capacity is being discussed in many communities.

The question arises, however, whether the development of a higher duty per acre on many projects might not receive more attention with greater benefit, both to those already constructed and to proposed developments. For example, a project not in the Southwestern states is said to have used approximately five acre-feet per acre gross, and is now considering an additional acre-foot storage. It is obviously more economical to calk a leaking ship than to supply pumps. With more study of the problems of canal losses, efficient canal operation, farm use, farm distribution systems, and farm waste, the duty might be appreciably increased. If more labor, supplied in farm distribution, will increase the duty, this should be furnished and the water saved for use on new irrigation development. A national resource should not be wasted merely to increase the profit on the constructed areas.

It is questionable if water can be stored with benefit for a year of 50 per cent normal stream flow, as 1919 has been. Combined with the low supply is the increased demand due to less precipitation and higher average temperature. Since these periods are, perhaps, twenty years apart, and it is a good reservoir that does not lose 10 per cent a year, storage would prove of little value. In addition, the construction interest charge over a period of years might easily exceed the net value of the crop produced with the net period storage.

Storage facilities should be constructed wherever water can be conserved beneficially, but it is held that expansion should be planned for economic irrigation development and not to provide an additional supply when this encourages wasteful use of water.

Road Oils in Baltimore County

According to the report of the roads engineer, Baltimore County, Md., recently published, that county used 280,961 gal. of road oil during 1919. The total cost was $33,788.90, an average of 12c. a gallon.

A Swingbridge Accident of a New Kind; Repair of Damage

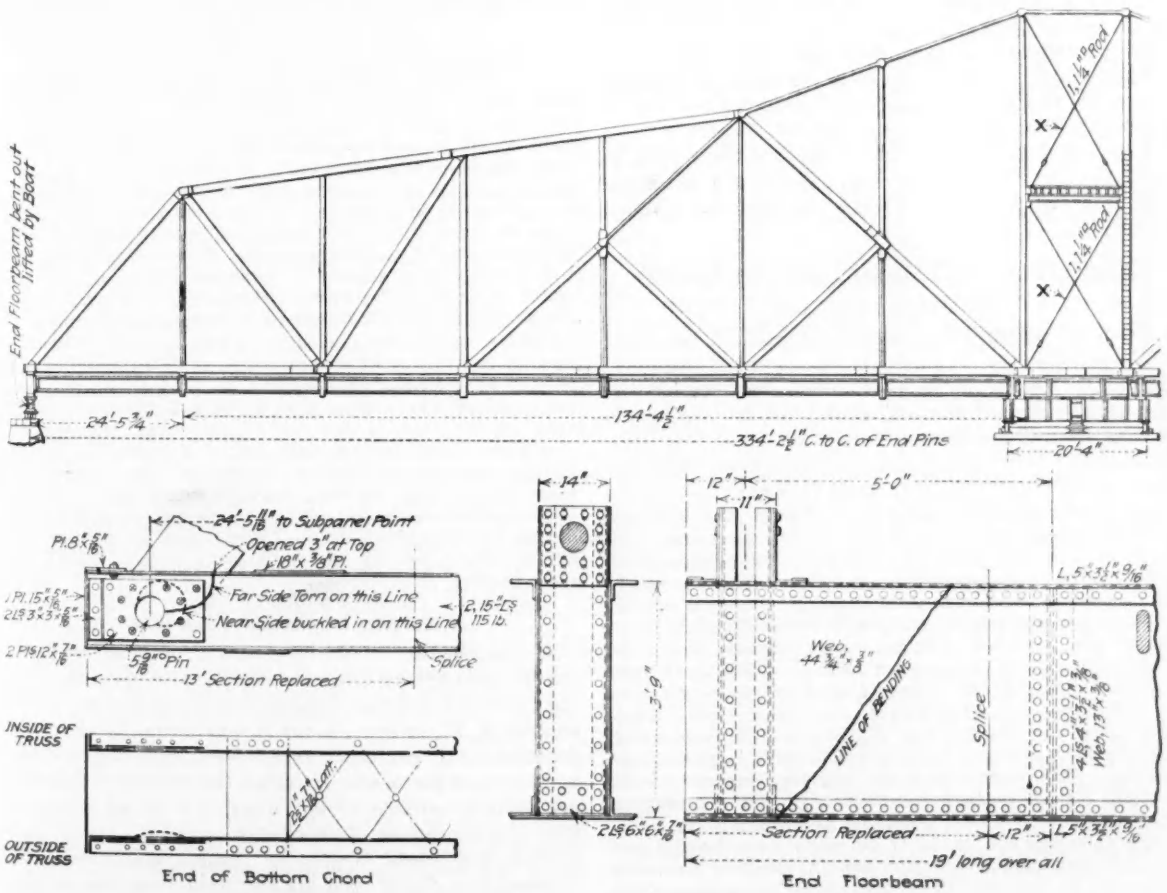
UNEXPECTED emergency conditions bearing on service and operation of swingbridges developed in an accident that involved the Southern Pacific railroad swing span across the estuary between Oakland and Alameda, Cal., on Jan. 5, 1920. As reported in our issue of Jan. 8, p. 109, a vessel striking the span at a low stage of the tide jammed its nose under one end of the 334-ft. span, and when the tide lifted the vessel it tilted the span to a dangerous degree and distorted it sufficiently to overstrain some members. Damage resulted from this distortion as well as from the collision itself. The bridge was out of service six days; the harbor entrance was blocked for 22 hours.

The accident occurred at 7:20 p.m. The draw had been opened to let vessels pass out when the steam schooner "Tamalpais," approaching in the opposite channel, attempted to pass through and struck the end of the span. Responsibility for the collision has not been placed; apparently neither the steamer captain nor the bridge tender foresaw the action of the other. The span was swung toward closed position in such a way that its end swept inboard on the port bow of the steamer, demolished the forward winches, snapped off the 2-ft. foremast, and wedged firmly on the forward deck of the boat, which sloped upward toward the bow.

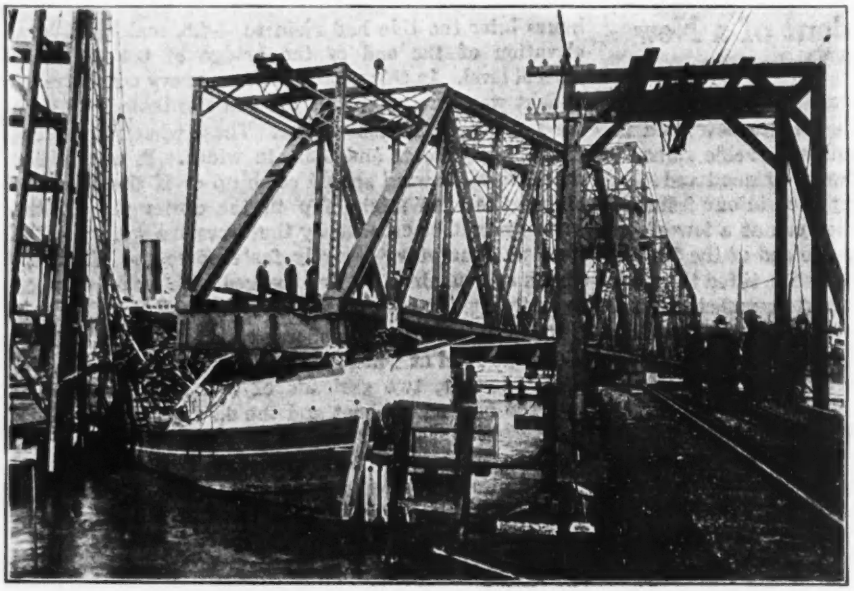
This occurred when the tide elevation was —1.6. Six hours later the tide had risin to +4.8, making a total elevation of the end of the bridge of 6.4 ft. above normal level. In this position a very heavy concentrated weight was thrown on four or five turntable wheels on the far side of the center pier. These wheels are about 18 in. in diameter and 5 in. in width. It was feared that if a high wind should come up or if the tide rose higher the span might slip off the center pier or the wheels might be crushed by the excessive weight. The span was therefore securely fastened to the pier with chains and turnbuckles, and wedged with blocks of wood so as to prevent rocking as much as possible.

At noon of the day following, the tide was 7.9 ft. above the level at which the collision occurred. By this time, however, two carloads of rail had been loaded onto the bow of the boat and the oil tanks in the stern had been emptied so that the bow floated some 14 in. lower in the water. To supplement these measures a heavy upward pull was applied to the end of the bridge by heavy tackle hung from the leads of a floating pile-driver. Under these conditions, shortly before the corresponding low tide on the day after the collision, two tugs were able to pull the steamer out from under the span. The span was then swung to its open position and put on falsework for repair.

The impact of collision broke the bottom chord, as shown in the accompanying sketch, and bent it so that it was thought desirable to cut it off with an oxyacetylene torch and replace a 13-ft. section. When the new



STRUCTURAL DAMAGE AND REPAIRS TO OAKLAND HARBOR DRAW
Operating lever of end lift was also bent, but this could be used again after straightening.



OAKLAND HARBOR SWINGBRIDGE; NOTE BUCKLED CHORD AND FLOORBEAM
End of draw jammed on bow of steamer by collision, and draw tipped. Released a day after accident.

section had been riveted on, the flange angles were welded together with the torch. A section of the floor beam was also renewed in the same way. Four tension rods in the tower, indicated by x x in the sketch, were stretched about 8½ in. This resulted from the stresses in the tower when it was tipped by the high tide. At that time there was even noticeable downward curve in the bottom chord under the tower posts on the side nearer to the elevated end. This curve disappeared, however, when the bridge was leveled. The stretched rods were taken out and cut off and then put back in the structure. No other serious damage to main members was found and the bridge was again in service on Jan. 11.

Interesting the Younger Men in Society Activities

HOW to secure the working interest of members, especially the younger members, of a technical society formed a large portion of the presidential address of Leonard Metcalf, March 17, in closing his term as head of the Boston Society of Civil Engineers. Some of the methods have already been tried with success. Mr. Metcalf tells of them as follows:

One of the most promising lines of work lies in efforts to bring together effectively in this Society the young engineers of different offices in this city and neighborhood, interested in special problems of design. These meetings should tend to broaden acquaintanceship, stimulate interest and give opportunity for really effective educational work. During the past year this movement was instituted and three such meetings have been held at which there were presented and discussed some interesting recent problems in foundations for structures on the water front. From 35 to 50 of the younger men of the Society attended each of these meetings, and a lively and helpful discussion has resulted. The interest aroused and the response of the younger men have been most friendly and encouraging. Their comment has been favorable and appreciative.

The meetings can probably be made more helpful and the diffidence of the younger men in speaking be better overcome, by limiting the attendance to the younger men, with but two or three of the older men, particularly experienced in the subject matter under consideration, present to assist in broadening and drawing out friendly discussion and comparison of ideas. The discussions can be vitalized by taking up specific actual problems recently faced by these young engineers in their daily work with which they are therefore so thoroughly familiar that they can speak upon them informally without effort. Additional meetings can then be held, to broaden the examples of the application of the theories involved. Oral presentations are to be encouraged, rather than written ones.

In this way groups of capable young engineers can be drawn together, and activity of interest in the work of the main society be gradually but materially stimulated.

Recent experience indicates further that it would be advantageous either to form a new section of the Society for this purpose, or to appoint a committee largely composed of the more active of the younger and middle-aged men of the Society, with perhaps two of the older men on the committee, who are in sympathy with the movement and whose greater acquaintance and experience would contribute to the breadth and sustained interest in this work.

An effort should be made to bring the older men into friendly touch with the younger men in every way possible and to the advantage of both.

Past-president Gow has made a very sensible suggestion that appears worthy of adoption. His proposal is that meetings be held during the course of the year in which some of the more experienced men be asked to give practical talks upon some phases of their engineering experience, their failures and successes. Arrangements should be made to have others join in the discussion at the same time, so as to broaden its scope. Every effort should be used to draw out the younger men. This actual participation would tend gradually to bring the younger men into closer touch with the Society, through the informality of the procedure and their interest in such practical matters.

In view of the rapid advance in cost of living and consequent inadequacy of current fund, it appears reasonable to use a portion of the income of the permanent fund for social activities, which may bring men into closer touch with one another in advance of and after the regular meetings. Unless this is done either the activities of the Society must be curtailed or the dues raised. Action has been taken along this line, by authorizing the Board of Government to make use of the current income of the fund during the year 1919-1920. The present, as well as the future generation of engineers, may justly benefit by these funds.

Colorado Engineers Classified

A classification of its members by classes, was recently made by the Colorado Society of Engineers with the following results: Eminent engineers, 2 per cent; engineers, 38 per cent; assistant engineers, 35 per cent; draftsmen, 15 per cent; instrument men, 6 per cent; surveyors, 4 per cent. As rated the eminent engineers are entirely outside of any class, due to some particular attainment or distinguished service. The classification was based largely on present occupation and followed the fairly well standardized positions of the civil engineering branch.

LETTERS TO THE EDITOR

Prohibition and the Foreign Born

Sir—In an editorial in your issue of April 15, p. 747, you name prohibition as a factor that is deterring immigration, but it seems to the writer that you should bring forward some more stable evidence than the vaporings of a professional jokesmith and a pro-booze advocate.

To refer to George Washington is not evidence, because the Father of his Country also kept slaves, and wore knickerbockers and a three-cornered hat. If he were with us today he would give a fair trial to a law which has passed through all the checks provided by our constitutional government.

The three-months' period which has elapsed since the prohibition amendment went into operation is entirely too short a time to determine the effect upon the peoples of foreign countries. It has been reported that immigration is increasing, and that Italy is taking steps to provide for a large exodus of its men to this country.

If you have any real facts you should publish them. Leacock is probably trying to perpetrate a joke, and it seems to be on *Engineering News-Record*.

LEWIS D. RIGHTS,
New York City. Civil and Consulting Engineer.

["Who's Who" gives the following facts regarding the "jokesmith." "Leacock, Stephen Butler; B.A., Ph.D., F.R.S.C., Litt.D., Fellow Royal Colonial Institute, Head of Department of Political Economy, McGill University, Montreal." Evidently Professor Leacock's reputation suffers from his avocation.—Editor.]

How the Mayor of a Southern Town Saved "Engineering Expense"

Sir—A certain small town in the South was preparing to make some street improvements, paving, storm water drainage, curb and gutter, etc. Several competent engineers, learning of the proposed improvement, made application in person to the mayor of the town for the position of engineer. The mayor very candidly ignored the applicants, with the statement that he did not need an engineer, that he wanted a first-class contractor, who could do first-class paving.

A contractor was sent for, who promptly went to the mayor. He was told by the mayor that the town had $150,000 to spend on paving the streets and he wanted to know of him how much street he would pave for that amount of money, and give the town a turn-key job. The contractor replied that he could not say off-hand, first, because he didn't have any engineer's specifications or quantities, and, secondly, the class and kind of pavement would largely determine the extent of pavement the stated amount would pay for. He didn't know how much storm severage was necessary, together with the different diameters, and the exact measurement and kind of pavement wanted was the absolutely necessary information he must have before he could make any intelligent proposition to the town.

He ventured the opinion to the mayor that the first thing for the town to do was to employ a competent municipal engineer to make surveys, draw up plans and specifications, and an estimate of the quantities, that is, give in detail the number of feet and diameter of all storm sewerage to be installed, the number of lineal feet of curb and gutter to be built, and the approximate number of cubic yards of excavation, and the number of square yards of pavement desired. The mayor very promptly told him that no storm sewerage was necessary, and that there would be no need of change of the granite curb, for he himself had placed that and knew that it was placed right, and that there was no grading to be done, except a few small bumps which he expected the contractor to do for nothing. He would not employ an engineer under any consideration, but the contractor might employ a dozen if he saw fit, but there would be no engineering expenses to the town.

The contractor told him that he would think the matter over and make him a proposition, and departed. The contractor got in touch with one of the engineers who he knew had applied for the engineering and was familiar with the proposed improvement, and had him go to the town and make some surveys and observations, and subsequent calculations. While the engineer was making the surveys, however, the mayor came to him and asked him what he was doing, and who employed him to do this work. The engineer informed him that he was doing it for the contractor. This satisfied the mayor, and the engineer completed his work and gave the desired information and data to the contractor.

The contractor agreed with the engineer that he was to supervise the engineering of this work throughout its progress to completion in the event the job was landed, it being stipulated that the engineer would receive a percentage of its total cost for his professional services. The contractor made a bid at the prevailing prices, and simply added the engineer's percentage to the bid, and presented it thus to the mayor. The proposal was not on a competitive basis, but in the nature of a private deal. The mayor was so highly pleased with the prices that he immediately and without further question awarded the contract to this contractor. So the town is now, as the mayor thinks, to be paved upon an outlay of something over $150,000 without the ostensible services of an engineer at the expense of the town.

N. C. HUGHES, JR.,
Chief Engineer, Laurens County Highway Commission.
Laurens, S. C.

Weariness Caused by Conduct of Am. Soc. C. E. Meetings

Sir—Your correspondent from the Middle West whose views on engineering society meetings are expressed in the column "Impressions Here and There" in your issue of April 8, p. 728, is right, but he does not realize that, besides the weariness that comes from overcrowded programs, from proceedings starting 3½ hours after one leaves one's office, from ill-considered programs often presented under indifferent presiding officers, the New York members also have been wearied at the quiet persistence which has overcome all efforts to make the meetings of real interest.

We are now trying to start a New York Section to try and correct these things. Out of nearly 2,000 potential members, however, hardly 200 have joined it, because of this weariness, and the indifference bred of long experience.

It is to be hoped, however, that before the first annual meeting of the New York Section on May 12, a large majority of the members in the Metropolitan district (District No. 1) will have joined the New York Section and will turn out in force on that date to demonstrate that though we may have been weary in the past at the administration of the American Society of Civil Engineers in New York, we still have a "kick" left as engineers, and we hope to make this section a live as well as dignified one.

New York City. F. LAVIS.

Economic Highway Construction

Sir—In a letter printed in the March 4 issue of *Engineering News-Record*, p. 486, a correspondent argues that "it is contrary to the spirit and needs of the times" to attempt to limit the abuse of the highways by overloading trucks. He seems to think that such a move would "tend to check the development of transportation" and offers as a substitute for weight of traffic laws the building of fewer miles of highway, but those miles capable of carrying trucks of twice the size of those in service today. It is unfortunate that figures are not presented showing the economic benefit of such a procedure, especially to those communities which will be obliged to forego good roads in order to assist other communities financially in building roads capable of carrying the super-trucks of the future.

It is true that the history of transportation, especially upon the railroads, shows a steady increase in the size of load carried. There are, however, many miles of railroad, especially branch lines and logging railroads, that have not adopted the 200,000-lb. capacity car nor the 250-ton locomotive. Neither does the development of transportation indicate the probability of the universal adoption of such units, nor is there any demand that all track and bridges be rebuilt to carry such loads. One cannot therefore argue that the history of the development of transportation proves that it will be necessary to build our highways for trucks with double the carrying capacity of those now in use. It may prove this for 5 per cent of our roads, but certainly not for all of them.

The problem is an economic one, and data are being rapidly accumulated on which a solution may be based. That road should be constructed for which the sum of (1) interest upon the first cost, (2) the yearly cost of maintenance and repairs, (3) the annual charge for reconstruction when worn out and (4) the annual cost of conducting transportation upon the road is a minimum. This sum, moreover, must be assessed against the general public, the property owners and the users of the road in accordance with the benefit derived by each class from the improved road, and will involve graded vehicle license fees, a gasoline tax, general taxation and special improvement taxes upon property. If the saving in the cost of conducting transportation by the use of heavier loads (requiring full loads in both directions) exceeds the interest and excess maintenance charges on the more expensive road required to carry the traffic in large rather than in small units, then the stronger road should be built. If this saving is not shared by all who pay for and use the road, the extra expense of the stronger road should be assessed against those who do benefit by it, in order that the economic benefit may not be overestimated. On some very heavy traffic roads a complete consideration of the problem of conducting transportation will require an estimate of the cost of improving, extending or building new railroad lines to handle part of that traffic. It is well known that railroads can handle freight above a certain minimum amount per year for a few cents per ton-mile, including the cost of the roadbed, while few trucks are handling freight for less than 15c. per ton-mile, not including the cost of the roadbed. The cost of this roadbed is paid for by the public, generally indirectly but none the less surely. A neglect of this fact is liable to do serious damage to the movement for good roads in this country. Propagandists cannot fool all the people all the time, nor can they defeat the laws of economics.

H. E. PHELPS,
State College of Washington, Dept. Highway Engineering.

Elevating Outer Rails for Fastest Trains

Sir—My attention was attracted to the abstract of the report of the Bureau of Safety of the United States Interstate Commerce Commission which appeared in *Engineering News-Record*, Feb. 26, 1920, p. 433, under the heading, "Speed too Great for Elevation of Outer Rail Caused Derailment." I read it with a good deal of care. The reasoning of the engineer who made this report, reminded me of the Swede who went into a liquor store (previous to July 1, 1919) and asked the clerk if he had any squirrel whiskey. The clerk said, no, but that he had some Old Crow, to which the Swede replied, "Yumping yemming, aye don't want to fly, aye yust want to yump around a leetle."

The reason that I am writing this letter is that to the non-technical man, this report may seem plausible and some of our railway presidents and managers may arbitrarily order that curves be elevated for the speed of the fastest trains, which would bring about disastrous results. The statement is made that "the speed of a train seldom reaches the point where it actually overturns; long before such a speed is reached the speed is sufficient to cause the equipment to rock back and forth until finally the wheel climbs the rail and results in derailing the train."

I know of one case where a young brainless freight engineer was in charge of an engine hauling an excursion train and he ran down a hill at a speed of 60 to 65 miles per hour until he struck an 11° curve elevated about five inches and the coaches actually turned over. This is not guessing: The section men who were working near the location saw the train coming and ran for their lives. It was also witnessed by a farmer and some of his family who lived close by.

I have seen and heard of many derailments caused by wheels mounting the outer rail on account of the elevation being too great for the speed, but this is the first time that I have ever heard of the reverse. Some twenty years ago I was acting superintendent of a mountain section of newly built railway crossing two ranges of mountains. The grades were 2.2 per cent and the maximum degree of curvature 14°, maximum elevation 4½ inches. We had a schedule of 25 miles per hour but as that speed could not be maintained on the up grade the result was that our passenger trains often ran 37 miles per hour down the hills. I was personally very often on these trains when such speeds were made and I can assure you there was no "rocking back and forth." We later reduced the schedule speed not so much for fear of derailments but for fear of breaking a rail or flange, as most of the equipment used was carried on cast iron wheels. Imagine this condition and decide for yourself which is the safer, riding 40 miles per hour over an 8° 10′ curve elevated 4¾ inches or riding 20 miles per hour over the same curve elevated 8½ inches. The outer rail must be depended on to guide the equipment around the curve regardless of the speed and the greater the vertical pressure of the wheels on this rail the less the liability of the outer wheels mounting the rail.

For a further discussion of this last mentioned feature see page 931, Volume 20, *American Railway Engineering Association Proceedings*.

J. G. SULLIVAN.
Winnipeg, Man.

The Relation of War Taxes to Increase in the Cost of Living

Sir—I have been very much interested in your recent articles on economics and particularly in those comparing the 1914 and 1919 cost of living.

There is one matter, however, which does not seem to me to have received the attention that it should and that is the percentage of the increased cost that is due to taxes, particularly war taxes. With the numerous bases used for the estimates and graphs, it is rather difficult even to estimate whether the tax factor has been taken into consideration. To illustrate: When the curves cross in the graphs in Mr. Baker's article in the Feb. 19 issue, does it mean that exactly the same amount of commodities (including rent, amusement, etc.) can be purchased as could have been secured in the base year; or does it indicate that the same can be purchased minus the amount necessary to pay the war taxes?

This matter was brought rather emphatically to my attention by a recent statement that two-fifths of the total increase in costs in England was due to war taxes. While I would not vouch for this figure, much less use it in computations on prices in this country, I believe that it is universally admitted that war taxes are a potent factor in increasing our cost of living.

R. B. EVERETT.
Saranac Lake, N. Y.

[The articles referred to did not discuss the causes for the increase in prices that has taken place. Undoubtedly the war taxes have played a part in this increase; but probably not a very large part. Taxes collected from business concerns form, of course, part of the expenses of operation and the price of the product must cover this cost if the company is to remain solvent. With demand outrunning supply, however, as it has done during the past year in many industries, the producer would be likely to keep up his prices even if the excess profits tax were taken off. Again the bulk of the war taxes are taxes on personal incomes, and these tend to lower commodity prices rather than raise them since they reduce the amount which the taxpayers have to spend in buying goods.—EDITOR.]

A Reverse Curve Problem

Sir—In Searles' "Field Book," issue of 1903, p. 97, is given a problem to join two curves with a tangent when the curves are reverse to each other. The solution given is approximate and requires that part of the work shall be measured in the field. Other solutions are given in *Engineering News*, Nov. 6 and Dec. 18, 1902, pp. 382 and 524, and Jan. 8 and Feb. 12, 1903, pp. 36 and 152. But all these solutions depend on some measurements taken in the field.

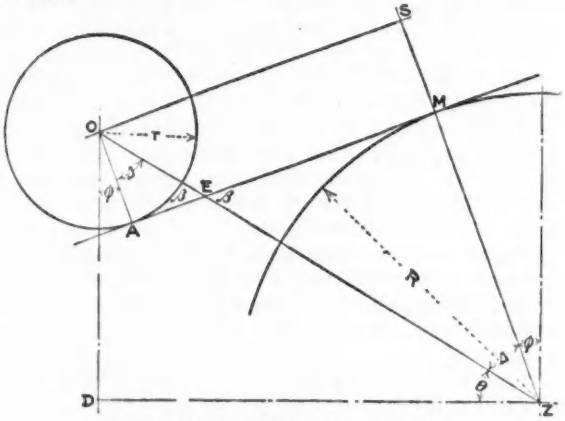


DIAGRAM OF CURVE PROBLEM

We have had occasion to determine an exact solution in a case where both radii and the distance between centers of curves were known, and the exact tangent points and distance were required. The solution given herewith is by Luther D. Beckley, one of our associates, and it is curious to find that so simple a solution has not found its way into the handbooks.

Problem: To find angle ϕ and tangent *A E M:*

Known : R, r, OD and DZ

$$OD = DZ \tan \Theta$$

$$\tan \Theta = \frac{OD}{DZ}$$

$$OZ = (R + r) \sec \Delta; \text{ or } \sqrt{\overline{OD}^2 + \overline{DZ}^2}$$

$$\sec \Delta = \frac{OZ}{R + r}$$

$$\phi = 90° - (\Delta + \Theta) = \textit{angle required}$$

$$\left.\begin{aligned} AE &= r \tan A \\ EM &= R \tan A \end{aligned}\right\} AE + EM = \textit{tangent required}$$

WILLIAM H. ADAMS,
Consulting Engineer.

Detroit, Michigan.

Mr. Humphrey's Topsoil Theories Criticized

Sir—Mr. Humprhey's article appearing in *Engineering News-Record*, March 18, p. 566, has been read with interest. The statement that nature, through the ages, has been preparing a crust for road purposes applies equally well to the soil at most any reasonable depth; in fact, the soil two feet below the top was formed years before the top soil and usually by the same process. Some of the best dirt roads of the state are in this county, and the soil on which they lie was placed by the hand of man. The value of soil as a road surface depends upon the kind of material and its drainage more than upon its age.

Highway specifications state that no organic matter be placed in fills, means, as every engineer knows, that no sod or grass be placed.

I wonder if Mr. Humphrey has ever observed a roller passing back and forth across a strip of sod in a fill, and has seen the sod spring back to its original position after the roller had passed, or if he has ever seen a trench cut through an old fill into the original surface. The original ground surface is as clearly marked as if it had been painted, and one can, even after years, pull the old sod and grasses from under the fill with ease.

His point as to getting water away as soon as possible is well taken, and every highway engineer has this point ever in mind. But perhaps Mr. Humphrey is not aware of the cries that go up from the farmer and boards of commissioners when culverts are placed for the purpose of running water into the fields.

Clay, when kept dry, is most suitable. I know of places on the National Pike where the old surface was cut from 2 to 10 ft., and they are in perfect repair after standing the war traffic and other heavy traffic for four years. I cannot conceive of a highway engineer placing a surface so low that it cannot be drained. He will endeavor by every means to get his surface higher with drainage in view. It should be not only "on a level with, or a little above, the surrounding land," but as far above as economy will permit.

I believe engineers generally recommend sowing grass on berms and slopes. The maintenance manual of the highway department in this state has in italics that "it is generally desirable to have the slopes of all types of roads sodded." Fertile soil is good but not essential. There are grasses that will grow in every soil, from sand to shale.

The description of the road maintained is highly interesting and I wondered at letting the water run along the road until I read further and found that the heaviest grade was 2 per cent. Heavier grades would have played havoc with the road. Even with flat grades, it would not have been very pleasant to have traveled this stretch of road in your new car just after a heavy rain. The statement at the end of this paragraph that the road had been corduroyed years before leads to the question, if it was corduroyed, how was it possible to have only top soil for a surface, as nature placed it?

If this theory of laying roads along the original surface is true, then every railroad in this country is built wrong. It would have been much cheaper for them to have laid their tracks across long, level bottoms, on the ground, instead of building embankments miles long. But they did so arguing that in order to counteract the force of capillary attraction and thus keep a fine, dry base, it was essential that they keep well above the adjacent surface. Time and observation have proven this theory correct.

Good highway engineering means the least expenditure in order to procure the best road with a minimum upkeep and minimum operating cost.

G. E. MATTINGLY.

Cambridge, Ohio.

Early Results of Iowa Registration Law

Twice the most sanguine estimate of the number of engineers within the State of Iowa have registered under the new registration law. K. C. Kastberg, secretary of the State Board of Examiners, told the members of the Iowa Engineering Society at the recent Fort Dodge meeting that 1672 application blanks were requested and that 1142 of these had come back filled in. Nearly 1,000 certificates have been granted so far. Three classes of certificates are issued: for professional engineers, for land surveyors, and for both combined. Already the law has had its effect on the public although in operation only since Jan. 1. Ten calls have come to the board asking for the names of registered engineers who might be available in a particular locality. In taking office the board members were instructed by the governor to proceed not only on the theory of protecting the public but also of improving the status of the engineering profession. Until some workable reciprocity arrangement can be effected with Illinois, certificates of about fifteen consultants in that state are being held in abeyance. Some difficulty arises from the fact that the Illinois law is for structural engineers only.

HINTS FOR THE CONTRACTOR

Wire Bags, Filled With Cobbles, Prevent Scour

BY ALBERT A. NORTHROP
Stone & Webster, New York City

WOVEN galvanized wire which is known commercially in the United States as "Cyclone Fence" is being used extensively by the railroads of Chile and Bolivia where embankments are in danger of scour. Blocks of cobbles, broken stone or boulders are built up in any size or shape desired and surrounded with

STONE FILLED WIRE BAGS TO PREVENT SCOUR

wire mesh which frequently is woven on the spot by means of an extremely simple machine that can be fastened to any carpenter's bench. The photo above shows one of these stone piles held in place by the mesh.

These bundles of stone are used as extensions to abutments, diagonal fenders at the base of an embankment to ward off the stream and are even used to repair a break. Bags of the stone are made and rolled into place until a sufficient foundation has been established upon which loose fill can be dumped. Their use is as varied as the ingenuity of the person protecting the embankment or diverting a river can devise. Frequently willow branches are stuck between the stones or between the blocks themselves where they take root and after a time form themselves into a willow hedge.

Sand Sluiced to Centrifugal Pump

REMOVAL of excavated material by sluicing through a trough to a centrifugal pump was the method employed in making the excavation for a water control basin on the canal system of the Lake Worth Drainage District of Florida. About 600 cu.yd. of fine sand had to be handled, but as the location was difficult of access the contractor did not wish to employ a derrick. The basin was located in a canal full of water, this being dammed or bulkheaded at each end of the excavation.

A timber flume, 150 ft. long, was laid along the bottom of the excavation and water was kept flowing through this by means of an 8-in. siphon at the upper end. A plank gangway was laid along the length of the flume. Men shoveled the sand into the flume, which delivered it to a sump for a 12-in. steam-driven centrifugal pump, this pump handling also the seepage water. The sump was at one corner of the pit, and its bottom about two feet below the lowest point of excavation.

The lift was 16 ft., but owing to the flexibility of the pump it was possible to reduce its speed without breaking the suction and thus to regulate its capacity according to the amount of water to be handled. Special care was taken to keep control of the water level so as to avoid pumping it too low and starting a flow of sand under the foundation. J. C. Wagen, Lake Worth, Fla., is chief engineer of the District. The contractors are Wills & Son & McCarthy, West Palm Beach, Fla.

Physical Effects of Pneumatic Tools on Limestone Workers

EFFECTS of pneumatic tools on the hands of workmen, reported by the Bureau of Mines, have been investigated by Dr. F. M. Barnes of St. Louis who was retained by the operators to study conditions in the Bedford (Ind.) limestone region. The workers are subject to a disorder particularly of the left hand known as "white fingers." The first effect is described as a feeling of coldness and pricking; the fingers then turn white and become numb. If the hands are warmed, rubbed or exercised the abnormal feeling soon passes. It is a temporary condition creating no permanent disability nor connecting it with any known disease. The cause is (1) mechanical irritation of the skin, (2) continued muscular contraction of a cramping nature, (3) low temperature. The latter is the most important, for the condition occurs in winter only. It cannot be attributed to the pneumatic tools alone, for it does not appear in summer when these tools are most used, and it affects also stone workers who chisel and mallet only.

Suggestions to prevent occurrence of the ailment are to keep the tool warm. An enlargement and covering of the chisel shank would also constitute a marked improvement by making it possible to hold the chisel without cramping the hand. Gloves help and the disorder diminishes if the workman discontinues the prevalent practice of blocking the exhaust with the thumb or finger of the right hand forcing a draft of cold air along the chisel to the fingers of the left hand.

NEWS OF THE WEEK

New York, April 22, 1920

Results of American Society of Civil Engineers Vote on Questionnaire Covering External and Internal Relations

(Polls Closed April 14, 1920)

A. External Relations

1. Shall the American Society of Civil Engineers "adopt the principle of becoming an active National force in economic industrial and civic affairs"? (See paragraph in Division C of Report* at top of p. 10.)

Yes.....2889 No..... 910

2. Shall the Society actively co-operate with other engineering and allied technical associations in promoting the welfare of the Engineering profession? (Report, Division C, pp. 10-19.)

Yes.....3115 No..... 685

3. Shall the Society for the purposes set forth in Questions 1 and 2 actively co-operate in the creation of the comprehensive organization as outlined in the Joint Conference Committee Report? (Report, Division C, pp. 10-19.)

Yes.....1867 No.....1954

B. Internal Relations

1. Shall the recommendations of the Committee on Development as to technical activities be adopted? (Report, Division A, Section 1-5, pp. 4-6.)

Yes.....2864 No..... 711

2. Shall local sections be created to embrace the entire membership of the Society? (Report, Division B, Section 1, paragraphs a, b, c and h, p. 6.)

Yes.....2854 No..... 831

3. Shall the directors in each geographical district be nominated and elected by vote of the corporate members resident therein. (Report Division B, Section 1, paragraphs e, f and g, p. 6.)

Yes.....3176 No..... 567

4. Shall a portion of the Society dues be allotted to local sections? (Report Division B, Section 1, paragraph i, page 6.)

Yes.....2561 No.....1130

5. Shall the present Nominating Committee be abolished and candidates for the office of President, two Vice-Presidents and Treasurer be nominated by representatives of local sections in annual conference? (Report, Division B, Section 1, paragraphs j and k, pp. 6-7.)

Yes.....2613 No.....1091

6. Shall the dues of all non-resident members above the grade of Junior be increased to provide for greater activities of the Society, said increase not to exceed $5 per annum?

Yes.....2583 No.....1149

7. In case it should be found that the activities brought about by the movement to expand both the internal and the external work of the Society would require more funds than would result from the increase in dues contemplated in Question 6 of Internal Relations, would you favor increasing the dues of all non-resident members above the grade of Junior by an amount greater than $5 but not greater than $10 per annum?

Yes.....1701 No.....1976

* The "Report" referred to is the report of the Committee on Development to the Board of Direction, submitted Oct. 14, 1919.

Am. Soc. C. E. Votes Against Federation Plan

Question 3, of Questionnaire Submitted for Letter Ballot Defeated by 87 Votes—Total of 3,913 Ballots Canvassed

By a margin of 87 votes the membership of the American Society of Civil Engineers has defeated the proposal to co-operate actively with other engineering organizations "in the creation of a comprehensive organization" to secure united action of the engineering and allied technical professions in matters of common interest to them. This decision is the outstanding feature of the vote on the questionnaire, canvassed April 14, containing 10 specific inquiries as to the future conduct of the Society's external and internal relations. The total valid ballots cast were 3,913, representing about 45 per cent of the corporate members entitled to vote.

The questionnaire was based upon the report of the Society's Committee on Development and on the Joint Conference Committee report made by representatives of the four national engineering societies. The form and subject matter of the questionnaire was the chief feature of the American Society of Civil Engineers' annual meeting in New York in January, at which time the decision was reached to canvass the corporate membership of the organization by letter ballot. The complete results of the canvass are indicated in the tabulation on this page.

Question 3 under "External Relations" and question 7 under "Internal Relations" were defeated; all of the others passed. Question 3, involving the proposal of a federation of engineering societies for non-technical work, was the one upon which the opinion of the Society's membership was most sharply divided, the conservative element having carried out an active campaign for its defeat, while a rival faction of the organization was equally energetic in its efforts to have question 3 answered in the affirmative.

An analysis of the vote shows that the New York and Illinois districts cast the heaviest vote against Question 3, while the Pennsylvania region voted almost 2 to 1 in the affirmative. District 1 (New York City and vicinity) and District 3 (New York State, exclusive of District 1, and the Province of Quebec) voted heavily against question 3. District 8 (Illinois) also opposed Question 3, as did Districts 2, 5 and 9, the latter three by very close votes. Question 3 found its main body of supporters in Districts 4 (Eastern Pennsylvania, Maryland, New Jersey and Delaware); 6 (Western Pennsylvania, West Virginia and Ohio); 7 (On-

tario, Michigan, Wisconsin, Minnesota, Manitoba, Iowa, Illinois, Indiana, Kentucky and Tennessee); and 11 Texas, Mexico, New Mexico, Arizona and Southern California). The remaining districts of the Society were about evenly divided in their vote covering the comprehensive national organization for civic and welfare work. The vote by districts on Question 3 is tabulated herewith.

VOTE BY DISTRICTS ON QUESTION 3
(External Relations)

District	Yes	No
1. (Resident)	214	572
1. (Foreign)	21	35
2	134	135
3	73	215
4	273	108
5	111	126
6	237	134
7	169	84
8	121	150
9	91	94
10	89	82
11	149	85
12	89	58
13	96	76
Total	1,867	1,954
Majority	.....	87

Question 7, involving an increase of dues for non-resident members above the grade of Junior, was defeated by a majority of 275 votes.

By its vote on the questionnaire the membership of the Society has expressed its wish to become "an active national force in economic, industrial and civic affairs," to "co-operate with other engineering and allied associations in promoting the welfare of the engineering profession," but in so doing it has refused to be a party with other organizations in the creation of the "comprehensive organization" for civic and welfare work as provided for in the report of the Joint Conference Committee, and involving the acceptance of the principle of a federated engineering body.

The formation of local sections embracing the entire membership of the Society has been endorsed and approval has been given to the proposal that directors in each geographical district be nominated and elected by vote of the corporate members resident therein. The vote will result in the abolition of the present nominating committee and the nomination of officers by representatives of local sections in annual conference.

Comment on the results of the questionnaire will be found in the editorial columns of this issue.

Zoning Studies Being Made for Dallas

Zoning studies at Dallas, Tex., are being made under the direction of the Metropolitan Development Association, a co-operative organization of various civic interests. The Association has engaged Robert H. Whitten, city zoning expert of New York and Cleveland, to direct its zoning studies. Charles Saville is secretary-manager of the Association, E. A. Wood is resident engineer, and George E. Kessler, of Kansas City, is city planning consultant.

Close Vote on Construction Service in Senate

When Senator Lenroot's proposal to strike out the section of the army reorganization bill which provides for a separate construction service came to a vote in the Committee of the Whole, it was lost by just one vote. The closeness of the vote stimulated all interested to muster their friends for the final vote taken in the Senate proper. The opposition to a separate construction service proved to be much stronger in the Senate than had been anticipated. Senator Lenroot is credited with changing a number of votes by the arguments which he presented against the separate service. One of the most telling points made by the opposition was in their connecting the construction service with the cost-plus contracts. It was pointed out by those desiring a separate construction service that the cost-plus policy did not originate in the Construction Division but was a heritage from the Council of National Defense which bore the approval of the Secretary of War, and continued to have his backing despite the protest made by General Goethals. Senator Lenroot, however, was not convinced that the cost-plus system was adopted by the Construction Division under protest. He quoted from General Marshall's testimony before a congressional committee to show that he has been an exponent of the cost-plus contract.

Mr. Lenroot also pointed to charges of waste which have arisen in connection with the building program at home, while not a word of criticism has been heard concerning the construction abroad which was in the hands of the Engineer Corps. To show that the Engineer Corps was engaged in construction work on a large scale in France, Mr. Lenroot produced figures to show that it had built 17,120 barracks; 4,100 ft. of docks; 1,035 miles of standard gage railroads; storage space covering more than 500 acres, and hospitals for 280,000 beds.

Senator Sterling pointed out that the recent willingness on the part of the Quartermaster General to surrender his claim for the construction work was due to an understanding that the Quartermaster General would have jurisdiction over the operation and maintenance of the buildings constructed.

In contrast with the 23-24 vote on the Lenroot Amendment in committee of the whole was the vote of April 20 in the Senate proper, when the Lenroot Amendment to strike out the section providing for a separate construction service was defeated 16 to 38. Since the House by almost as decisive a vote rejected the construction service as a separate entity, it can be foreseen that the conferees will have great difficulty in reaching an agreement. An effort to add two brigadier-generals to the staff of the chief of engineers was defeated decisively. The number of engineer officers was increased to 650.

Municipal Improvement Bonds in Chicago Fail to Carry

Four bond issues aggregating $34,500,000 for municipal improvements in Chicago were adversely voted upon in Chicago, April 13. The money was to be apportioned as follows: $15,000,000 for street lighting; $9,500,000 for bridges; $5,000,000 for parks and playgrounds; $5,000,000 for a municipal convention hall. The city is so near the limit of its bonding power that a favorable vote would have meant an encumbering of the city's entire bonding power for the next five years. Improvements now under way call for the expenditure of $35,000,000 of unexpended authorized bond funds, and if all bonds already authorized were sold, the city would be within $1,000,000 of the limit of its bonding power. The votes of the women were far more numerous against the bonds than were those of the men.

Hearings to Begin on Townsend Highway Bill

In connection with the presentation of the conference report on the Postoffice Appropriation Bill, Senator Townsend, the chairman of the Committee on Postoffices and Post Roads, announced that he intended to proceed with hearings on his national highway bill so that Congress may be given concrete information as to an improved highway policy. Senator Townsend emphasized the need of such an investigation as this time when continuity of good roads is so necessary in the general welfare in times of railroad strikes and when for other reasons the rail transportation facilities are unable to meet the needs of the public.

Senator Townsend declared that he is not at all pleased with the way Federal money is being expended in highway construction. He pointed out that many of the states apportion their federal-aid money among their counties in the same way that the Federal Government apportions it to the States, that is, according to population, territory and mileage of roads. The result, the Senator stated, is "little patches of roads here and there all over a state, beginning nowhere, leading nowhere, having no system in view and being washed away in many instances by the first flood that comes after they have been completed. Sixty per cent of the federal aid already expended has been devoted to temporary roads. I maintain that present methods of expending federal aid funds are wasteful and inexcusable."

Before Senator Townsend would vote for another dollar for the federal aid fund, he will insist that a policy be adopted which will permit of connecting the road systems between states and provide for permanent maintenance. He will insist on a national system, built and maintained by the Federal Government for the good of the whole country.

Advise Am. Soc. C. E. Representation on War Memorial

Having found unsuitable all of the 67 proposals before it, the jury chosen by the Mayor's Committee on the Permanent War Memorial, New York City, has recommended a nation-wide competition, all the plans thus secured to be passed on by a committee of nine, one chosen at large and eight selected, one each, from lists of three submitted by eight societies, including the American Society of Civil Engineers, the New York Chapter of the American Institute of Architects and the New York Chapter of the American Landscape Architects. The final choices from the various lists, as well as the selection of member at large, would be made by the chairman of the Mayor's Committee on Permanent War Memorial. The jury is against any memorial that is wholly utilitarian in character. For a site it recommends that the War Memorial Committee consider a tract of land north of Dyckman St. lying along the Hudson River and Spuyten Duyvil Creek, some 4,000 ft. long and 1,500 ft. width, much of which is 200 ft. above the river.

Railroad Labor Board Appointed —Holds First Meeting

The Railroad Labor Board, for which provision is made in the Transportation Act, Feb. 28, 1920, was appointed by President Wilson April 14 and held its first meeting two days following, with seven of its nine members present.

The membership of the Board consists of George W. Hangar, Washington, D. C.; Henry Hunt, Cincinnati, and R. M. Barton, Tennessee, representing the public; Horace Baker, J. H. Elliot, and William L. Clark, representing the railroads, and Albert Phillips, A. O. Wharton, and James J. Forrester, representing the employees.

Under the terms of the Transportation Act, it is the duty of the Railroad Labor Board to render decisions in matters which local boards of adjustment have been unable to decide. It is also the duty of the Board to look into and, if it should be considered proper, to suspend wage arrangements entered into between the employees and the railroad management which might require action on the part of the Interstate Commerce Commission.

A. R. E. A. Will Join Council

The American Railway Engineering Association has accepted an invitation from the United Engineering Society to become a member society of the Engineering Council. The A. R. E. A. now becomes the sixth member society of the council. The other members are the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, the American Institute of Electrical Engineers and the American Society for Testing Materials.

Senate Adds $8,000,000 to Rivers and Harbors Bill

Appropriations for rivers and harbors made by the House of Representatives in its current bill totalled $12,000,000, which is very much less than the average spent in any one of the past ten or fifteen years. This sum, however, has been increased to $20,000,000 in the Senate bill which has just been reported out of the committee. The additional $8,000,000 seems to be voted to a number of small projects, most of them in the Southern States. Reading through the list, the Senate additions are Delaware River and Woodbridge Creek, N. J.; Northwest River, Sterlings Creek, Oyster Channel, York River, Carters Creek, Morattico Creek, all in Virginia; St. Marks River, Charlotte Harbor Channel, Santa Sound, St. Petersburg, St. Johns River, Apalachicola River, all in Florida; Tansas River, La.; Galveston Channel, Aransas Pass, Corpus Christi, and Rockport, Tex.; La Grue River, Ark.; Tennessee River; Kentucky River, Ky.; Los Angeles Harbor, Cal.; Tillamook, Tualatin, Ore.; Cumberland River, Tenn.; Willapa River, Wash.; Houston Ship Channel, Tex. It will be seen, with the exception of one in Southern California and three in the extreme Northwest, all of these are in the South. Nor do the North or Middle West figure very heavily in the House original appropriation.

Joint Water-Supply Scheme for Saskatchewan Cities

An investigation of the possibilities of a joint water-supply scheme for the cities of Regina and Moose Jaw together with some twenty to twenty-five towns and villages and ten or twelve rural municipalities is being made by a commission appointed by the Provincial Government. The chairman of the commission is A. J. McPherson, consulting engineer, Sterling Trust Building, Regina, and the secretary is W. C. Bettschen, also of Regina. A supply from the South Saskatchewan River is under consideration. *Engineering News-Record* is informed by Mr. McPherson that a rough estimate of the cost of the system at present prices ranges from $8,000,000 to $9,000,000 and that this would provide for some 200 miles of pipe up to 36 in. in diameter, pumping capacity of some 10,000,000 U.S. gal. per day against a total head of 400 ft., and works to remove sand and silt, besides four or five small reservoirs with a combined capacity of about 50,000,000 U. S. gal. The commission will report on the financial ability of the proposed district to provide for the work, as well as on a method for raising fixed charges and operating costs, and a system of administration. The commission hopes to carry its investigations far enough to warrant a popular vote on the formation of the proposed district before the meeting of the next session of the Provincial Legislature at the close of this year.

Senate to Investigate the Housing Crisis

The Senate has approved a resolution by Senator Calder providing that a committee of five Senators is to inquire into and report to the Senate as follows:

(a) The existing situation in relation to the general construction of houses, manufacturing establishments, and buildings, and the effect thereof upon other industries and upon the public welfare; and

(b) Such measures as it may deem necessary to stimulate and encourage such construction work, to encourage popular investment rather than spending, to foster private initiative in building, and to insure co-operation between labor and persons or corporations engaged in transportation, banking, or other business necessary to the development of such construction.

The committee is instructed to report prior to Dec. 1.

In explaining the need for the resolution, Senator Calder declared that the country is in need of $4,000,000,000 worth of buildings. Senator Calder stated that he proposes to resist with all the power he possesses in the Senate and elsewhere any effort to induce the government of the United States to go into the business of supplying housing for private individuals.

Pittsburgh Improvement Bonds Fail to Draw Bids

No bids were received April 8, the time fixed for receiving proposals, by the City Controller of Pittsburgh, for $7,281,000 of city improvement bonds. These bonds were a part of the $22,000,000 bond issue authorized in 1919 for city improvements, and were to bear interest at 4½ per cent. The failure to receive bids is due to the present condition of the money market, as 4½ per cent interest was considered insufficient in financial circles.

If the City Council acts promptly and increases the rate of interest, the work contemplated under this bond issue will only be delayed six weeks. The Director of Public Works is ready to advertise for bids for the different projects, but the contracts cannot be awarded until the bonds are sold and the money is in the city treasury.

The list of improvements covered by this bond issue and therefore delayed are as follows: Widening of Second Avenue, $1,410,000; Boulevard of the Allies, $1,140,000; street improvements (repaving mainly), $861,000; widening of Broad Street, Eastend, $777,000; widening of Ferry Street, $351,000; improvement of East Carson Street, $315,000; East Street improvement, $300,000; Beechwood Boulevard bridge at Shenley Park, $270,000; Highland Park improvements, $231,000; Saw Mill Run sewer, $210,000; Negley Run sewer, $210,000; Soho Run sewer, $135,000; improvements at Mayview Poor Farm, $99,000; Nine Mile Run sewer, $90,000; Island Avenue Bridge, $90,000; improvement of Baker Street, $90,000; Mount Washington Roadway (engineering work only), $30,000; Warrington Avenue improvements, $132,000; funding bonds, $540,000.

New York State Licensing Bill Passed by Senate

The bill providing for the licensing of engineers, introduced in the New York legislature by the New York Chapter of the American Association of Engineers and endorsed by the New York Section of the American Society of Civil Engineers and other engineering societies in the state, was passed April 15 by the Senate. It will be introduced into the Assembly immediately.

Start Work on Detroit Street Railway Project

Excavation for the foundation of the first section of Detroit's municipal street railway was started last week after the voters had approved the $15,000,000 bond issue to finance the extensions planned by Mayor Couzens and his street railway commission. Tentative arrangements had been made with a local contractor to start construction and as soon as the result of the ballots was assured approval was granted by the City Council, including the issuance of $100,000 in public utility bonds to meet the initial expenses of starting work.

The project, which includes the construction of 101 miles of new tracks with the necessary power houses and equipment, will be carried out under the direction of the Department of Public Works. A supervising engineer will be appointed to take charge of the construction and upon the completion of plans and specifications, bids will be asked and contracts awarded on foundation work. Rails and ties will be purchased directly by the city, according to present plans.

Madison Rejects Municipal Street Railway Ownership

The purchase of a privately owned street railway system at Madison, Wis., was defeated by a vote of three to one in an election held April 6. Had the vote been favorable the price would have been determined by the State Railroad Commission.

House Committee Favors Transfer of Road Building Equipment

The Military Affairs Committee of the House of Representatives has reported favorably the Reavis bill (H. R. 13,329) providing for the transfer of additional machinery and equipment from the War Department's surplus to the Bureau of Public Roads for use in highway construction. In reporting the bill, the committee emphasizes the need of suitable storage facilities for road building material and equipment, to be used in the forest reserves and which are provided for in the bill. Without this authority the Department would not be permitted to use its funds to provide these needed storage facilities.

To Loan Tractors for Road Work

Tractors may be loaned by the War Department to the states for use in highway construction, as the result of a provision embodied in the Postoffice appropriation bill. As agreed to by the conferees, the bill provides that the Secretary of War, in his discretion, may loan such tractors as may be spared, provided that all expenses for repairs and upkeep of the tractors as well as loading and freight charges are to be paid by the state.

Lang to Preside at Chamber of Commerce Industrial Section

As chairman of the Industrial Production Section of its eighth annual meeting to be held in Atlantic City April 26-29, the U. S. Chamber of Commerce has selected Charles F. Lang, president of the Lakewood Engineering Co., of Cleveland. For the past 10 years Mr. Lang has been in close touch with the most important engineering work in this and foreign countries. Starting his business career as cash boy in a department store he now heads a big industrial organization specializing in the manufacture of a great variety of construction plant and equipment.

Charles F. Lang, of Swiss descent, was born in Cleveland, March 27, 1871. At an early age it became necessary for him to leave the public school which he attended in order to work as a cash boy in a dry goods store. Later he took up the study of law with a firm of Cleveland attorneys, and until he completed his study at the age of 26 years he paid his way by working as a clerk. Following his admission to the Ohio bar he practised his profession in Cleveland for the succeeding twelve years. In 1896 he assisted in forming the Lakewood Engineering Co., but took no active office in the organization until 1910, when he gave up his law practice to devote his entire efforts to the promotion of the Lakewood Company, of which he is now president and treasurer.

In addition to presidency of the Lakewood Engineering Co., other offices now held by Mr. Lang in the field of industrial engineering are as follows: Director in the Allied Machinery Co., of New York, a subsidiary of the American International Corporation; director and vice-president of the American Safety Device Co. of New York; president of the Cameron Clay Products Co. of Emporium, Pa.; vice-president of the Duplex Foundry & Manufacturing Co. of Elyria, Ohio; director of the Lakewood-Galion Company, of Galion, Ohio; director of the Milwaukee Concrete Mixer Co. of Milwaukee, Wis.; vice-president of the Western Patent Scaffolding Co., Chicago; director of the Equipment Corporation of America, Chicago, and vice-president of the Cleveland Railway Supply Co., Cleveland.

Highway Work in Ohio Not to Stop

After a conference with deputy engineers and others interested in road improvement, Highway Commissioner A. R. Taylor has announced that road improvement in Ohio would go forward this year if the officials of the various counties, in which improvements are proposed, will consent to an increase in the estimate of highway costs. For a time it was believed that practically all highway work would be stopped because of the lack of bids on work already offered. Contractors have been loath to take a contract under present estimates because of the increase in cost of materials and labor, and delays in transportation of materials. However, with the decision arrived at engineers will re-estimate work which will be offered again.

Largest Single Unit Cotton Mill Under Construction

What is believed to be the world's largest cotton mill housed under one roof is to be built by the Aberthaw Construction Co., Boston, Mass., at Summersworth, N. H. The mill is to be built for the Great Falls Manufacturing Co., and when completed will be approximately 1,900 ft. in length and 144 ft. in width and either five or six stories in height. The estimated cost of the job is $7,500,000. A storage yard has been established at Summersworth, and men are on the job receiving materials. Actual construction will begin before the end of April. Lockwood, Greene & Co., New York City, are the architects.

Massachusetts Highway Program Totals $7,000,000

For highway construction, reconstruction, and maintenance work, the State of Massachusetts has approximately $7,000,000 to spend during the 1920 construction season. The project calling for the greatest expenditure will be, perhaps, that of the road from Orleans to Provincetown. This construction, totaling 25 miles, will be of a sand-asphalt mix, and the total work, which includes the widening of an existing road to 18 ft., will cost in the neighborhood of $400,000. A continuation of the Mohawk trail from Greenfield west will be of cement concrete construction and will cost near $350,000. This piece of construction entails heavy excavation and a certain relocation to reduce an existing 14 per cent grade to a 6 per cent grade. The Northampton and Pittsfield Road is to be improved with bituminous macadam, and with drainage and necessary bridges, will cost approximately $300,000. The Newburyport Turnpike from Newburyport to Boston will receive attention this season, six more miles of bituminous macadam being scheduled for construction. An estimate of the cost of the Newburyport improvement is $275,000.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston; May 4-6; Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; 63 E. Adams St., Chicago; May 10, 11, St. Louis, Mo.

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Aug. 30-Sept. 3.

PERSONAL NOTES

F. R. McMILLAN, for the past two years research engineer, Emergency Fleet Corporation, U. S. Shipping Board, has accepted a position in the New York office of the Turner Construction Co. Mr. McMillan was formerly an assistant professor in structural engineering, University of Minnesota. He was called to the shipping board at the time of the formation of the concrete ship section to develop apparatus and methods for the determination of stresses in ships under the action of the waves at sea.

JOHN A. STEVENS, engineer, Lowell, Mass., announces the opening of a branch office, in charge of Marcus K. Bryan, at 502 Frederick Bldg., Cleveland, thoroughly organized to render consulting services for the analysis, design, construction, and management of power plants.

L. I. GOLDBERG has resigned as engineer of the Michigan State Highway Department to engage in the contracting business at Traverse City, Mich.

HOWARD K. RUMBERGER, of Bellingham, Wash., has been appointed city engineer of Ferndale, Wash.

R. B. ABBOTT, formerly division superintendent, Philadelphia & Reading R.R. at Philadelphia, has been promoted to assistant general superintendent at Reading, Pa.

JOSEPH H. O'BRIEN, formerly vice-president and chief engineer, Central Construction Corporation, and previous to that association for 15 years with the Westinghouse, Church, Kerr Co., has been appointed chief engineer of the Foundation Co., New York City.

SAMUEL P. HALL, architect, recently of the Construction Division U. S. Q. M. C., and HAROLD M. BUSH, mechanical engineer, colonel of Field Artillery, A. E. F., announce the formation of the firm of Hall & Bush, for the general practice of architecture and engineering, and as specialists and consultants with particular attention to factories and other industrial plants. The firm has established connections with Henry V. Hubbard, professor of landscape architecture at Harvard University, late chief of the Division of Town Planning, U. S. Housing Corporation, for the treatment of housing problems, real estate developments and landscape architecture. The offices of the firm are at Columbus, Ohio.

HAROLD B. BARRY has been promoted from the position of district engineer of the St. Louis-San Francisco R.R., at Memphis, Tenn., to that of principal assistant engineer, with headquarters at St. Louis.

PERCY PENNYBACKER has resigned as assistant to the bridge engineer, Texas State Highway Department, to enter the employ of Harrington, Howard & Ash, consulting engineers, Kansas City (Mo.) as draftsman.

LIEUTENANT-COMMANDER J. N. LAYCOCK has been transferred from the Philadelphia Navy Yard to the Cape May Naval Station to take over the duties of the officer in charge of public works construction at that station. He was formerly head of the Technical Division of the Public Works Department, Philadelphia Navy Yard.

C. J. VICTOREEN has been appointed city engineer of Cadiz, Ohio.

C. W. WOOD, formerly assistant engineer of the South San Joaquin irrigation district, California, has been appointed chief engineer, succeeding R. W. Olmsted, who recently resigned to become chief engineer of the advertising firm of Foster & Kleiser, San Francisco.

GEORGE O. WITH, who recently resigned as city engineer of Joliet, Ill., is now manager of the Chicago office, Consolidated Expanded Metal Co., of Braddock, Pa.

HENRY OAKES recently resigned as city engineer of Muskegon, Mich., to engage in engineering work at Erie, Pa.

BRIGADIER-GENERAL WILLIAM L. MARSHALL, for the past ten years consulting engineer to the Secretary of the Interior, has tendered his resignation on account of ill health.

JOHN R. SEXTON has been promoted from division engineer of the Marion and Chicago sections of the Erie R.R., to regional engineer in charge of the Chicago region, with office at Chicago.

D. N. NEAL, office engineer of the Western Pacific R.R. at San Francisco, has been promoted to bridge engineer, with same headquarters.

B. E. CLARK, of McAlester; E. K. RAMSEY, of Oklahoma City; L. K. Forde, of Cherokee, and Clarence A. Wood, of Stillwater (Okla.), have been appointed, by the state engineer of Oklahoma, district engineers to supervise the work and make reports on the progress of projects in their respective districts.

C. FRANKLIN HUNT, recently with the engineering firm of Hoadley & Giles, Binghamton, N. Y., has been appointed village engineer of Endicott, N. Y.

FRANK SCHAAK, JR., transitman in the service of the U. S. War Department at Muscle Shoals, Ala., has joined the Missouri State Highway Department at Jefferson City, Mo.

W. C. BURNHAM, bridge engineer of Oklahoma, will leave the office of the state engineer some time during April to supervise the construction of the Calvin steel bridge, Federal Aid Project No. 16, Hughes County, Okla.

PUSEY JONES has been promoted from acting engineer of structures of the Boston & Maine R.R. to bridge engineer with office at Boston.

J. H. STEVENS, formerly with the New York State Highway Department, has been appointed village engineer of Massena, N. Y.

R. S. BELCHER, superintendent of the Somerville (Tex.) timber-treating plant, Atchison, Topeka & Santa Fe R.R., has been promoted to manager of treating plants for that system, with headquarters at Topeka. He succeeds G. E. Rex, who recently resigned to become vice-president, National Lumber & Creosoting Co., Kansas City.

A. E. TRIPLETT, division engineer, St. Louis-Southwestern R.R., at Pine Bluff, Ark., has been promoted to superintendent, with headquarters at Mt. Pleasant, Tex., succeeding H. H. Hooper.

E. E. ADAMS, consulting engineer, Union Pacific, with headquarters at New York, has been appointed assistant to the president, in charge of purchases, engineering and standards, with headquarters at Omaha, Neb.

J. O. PRESTON has resigned from the staff of the Rochester (N. Y.) Bureau of Municipal Research, Inc., to become assistant to G. H. Ley, chief engineer of the I. K. Davis Co., contractors and engineers, Philadelphia, Pa.

LIEUTENANT-COLONEL GEORGE D. SNYDER has been commissioned Colonel, commanding the 22nd Regiment, Engineers, New York Guard. He joined the regiment in 1915, serving with it on the Mexican Border in 1916, and when it was reorganized for the World War as the 102nd Engineers he served with it in all the actions with the 27th Division in Belgium and France. Colonel Snyder is a member of the firm of Jacobs & Davies, Inc., consulting engineers, builders of the Hudson tunnels.

F. E. O'BRIEN has been appointed assistant city engineer of Watertown, N. Y.

OBITUARY

DR. JOHN A. BRASHEAR, expert instrument maker, died at Pittsburgh, April 8. He was born at Brownsville, Pa., in 1840. After receiving a common school education, he became a machinist. He enlarged upon his elementary knowledge of astronomy, which had been imparted to him by his grandfather, until he won recognition as one of the most eminent astronomers and instrument makers in this country. After ten years' work he completed his first telescope, in 1874. In 1880 he turned his attention wholly to the manufacture of telescopic instruments. He invented the spectroscope for astronomic uses, and in 1888 completed his spectroscope for the 36-in. telescope. From 1898 to 1900, Dr. Brashear was the director of the Allegheny Observatory, during which time remarkable scientific researches were carried out under his supervision. During that period he was also acting chancellor of the Western University of Pennsylvania, now the University of Pittsburgh, and taught gratuitously in that institution for several years. He was one of the original directors of the board of trustees of the Carnegie Institute of Technology, and took an active part in its development. Dr. Brashear was past-president of the Engineers' Society of Western Pennsylvania and of the Pittsburgh Academy of Science and Arts. He was also an honorary member of the Royal Astronomical Society of Canada and a Fellow of the American Association for the Advancement of Science and of the Royal Astronomical Society of Great Britain.

FRANK AUBREY MARTIN, civil engineer, died at Waukesha, Wis., Jan. 29. He graduated from Missouri State University in 1912 and took a position as government inspector on the Keokuk dam. The following year he was appointed city engineer of Webb City, Mo., which position he filled until 1915, when he went to Topeka, Kan., as engineer for the Santa Fe. Two years later he became assistant county engineer of Shawnee County, Kan., from which position he was obliged to resign, owing to ill health, the latter part of 1919. Mr. Martin was 33 years of age.

ADOLPH GREEN, contractor, Green Bay, Wis., died suddenly, Feb. 27, at 69 years of age. One of Mr. Green's most important undertakings was the reconstruction of the railway bridge across Fox River, at Green Bay, in 1906. He retired from active duties in 1907, but up to the time of his death was president of the Adolph Green Construction Co., which was engaged in the construction of substructures for several bridges across the Mississippi, Platte and Fox Rivers.

Asphalt Association Holds Annual Meeting

George Otis Smith, director, U. S. Geological Survey, as the principal speaker at the annual meeting of the Asphalt Association held April 14 at the Engineers' Club, New York City, urged the necessity of greater quantity production of petroleum and its products. He made it clear that, while there has been a constantly increasing production from year to year, the demand continually outruns the increase, necessitating most intelligent and useful disposition of materials produced. Increased use of asphaltic materials in highway construction has made, said Mr. Smith, greater production in petroleum products imperative. Lieut.-Col. Cheney, U. S. A., explained the system of vocational training which is now a feature of army policy.

Officers elected for the following year are J. R. Draney, United States Asphalt Refining Co., President; J. M. Woodruff, Sinclair Refining Co., vice-president; Herbert Spencer, Standard Oil Co., treasurer. The old board of directors was re-elected with W. T. Headley, Headley Good Roads Co.; Carl F. Hetherington, of Hetherington & Berner, and James G. Clark, Standard Oil Co., as new directors representing the contributing membership, and with James Pearson, Construction and Paving Co., Ltd., and J. K. Hollinghead, Standard Bitulithic Co., representing the associate membership.

New members admitted to the Association include Cressy Road Sprayer Manufacturing Co., Everett, Mass.; Willite Road Construction Co. of America; Brooks Construction Co., Fort Wayne, Ind.; Butler Construction Co., Waukesha, Wis.; Constable, Hart & Co., Ltd., London; P. Flanigan & Sons, Baltimore; Kilmer & Barber, Ltd., Toronto; Southern Paving Construction Co., Chattanooga, and Union Paving Co., Philadelphia.

Prizes Awarded in Lakewood Engineering Contest

The first prize of $1,000, offered by the Lakewood Engineering Co., Cleveland, for the best treatise on industrial haulage, using Lakewood Tier-Lift trucks, has been awarded to Clarence Irving McNair, Jr., of Cloquet, Minn. Mr. McNair is secretary of the Northwest Paper Co., and his prize-winning paper was entitled "Analysis of the Application of the Tier-Lift Trucks to the Pulp and Paper Industry." The second prize was awarded to F. C. Peters, chief mechanical engineer, and G. R. Reese, assistant mechanical engineer, New Jersey Zinc Co., Palmerton, Pa. The third prize went to Theodore M. Prudden of the Whitin Machine Works, Whitinsville, Mass.

The committee making the wards, appointed by the Society of Industrial Engineers, was composed of A. Russell Bond, of *Scientific American Monthly*; Professor Dexter S. Kimball, Dean of the School of Engineering, Cornell University; and Irving A. Berndt, vice-president of B. E. Knoeppel Co. The standard of papers submitted was declared to be unusually high, and a large volume of data was added to present knowledge of methods of factory haulage.

BUSINESS NOTES

THE T. L. SMITH CO., Chicago, announces the opening of a New York City branch office at 50 Church St., and a warehouse service station, under the supervision of E. R. Marker, recently of the Milwaukee office, which will supply all territory east of Cleveland.

THE VICTOR L. PHILLIPS CO., Kansas City, Mo., conducting a general business in transportation and construction equipment, has purchased the business of Wiley Brothers, Oklahoma City.

THE LOCOMOTIVE CRANE CO., of America announces its removal from Chicago to its new plant at Champaign, Ill.

FRED J. PASSINO, who for many years has covered the Southwest for the Independent Pneumatic Tool Co., Chicago, has been appointed assistant manager of the Eastern division, with headquarters at 1463 Broadway, New York City.

THE MATHIESON ALKALI WORKS, INC., has moved its general offices from Providence, R. I., to 21 West 43rd St., New York. It announces that E. M. Allen has been elected president, succeeding E. E. Arnold, resigned; F. B. Richards succeeds J. R. Gladding as secretary and treasurer. The operating department will be under Max Mauran, vice-president; Colonel Charles A. Vaughn will be manager of the Niagara Falls works, and J. H. McMahon will be manager of the Saltville, Va., works. John A. Kienle, formerly sales manager, Electro Bleaching Gas Co., has been appointed general manager of sales, with E. E. Routh, formerly manager of bicarbonate sales, appointed as his assistant.

THE CEMENT-GUN CO., INC., Allentown, Pa., announces the following changes in position of various company officials: B. C. Collier elected vice-president, in addition to continued duties of general manager; W. J. Roberts advanced from vice-president to president; S. W. Traylor, formerly president, now chairman, board of directors.

WATER WORKS MANUFACTURERS' ASSOCIATION has changed its location from 18 East 41st St., to Room 1009, 25 West 43rd St., New York City.

THE THOMPSON-STARRETT CO., New York, has opened an office in the Perry-Bayne Building, Cleveland.